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P R O C E E D I N G S

OF THE

SELECT COMMITTEE, APPOINTED BY THE ONTARIO
LEGISLATURE, TO ENQUIRE INTO CERTAIN MATTERS
AND LEGISLATION REGARDING SMOKE CONTROL AND
AIR POLLUTION, IN ONTARIO.

Mr. A. H. Cowling, Chairman,
Presiding.

Dr. Frederick Evis, Secretary.

—0—

VOLUME V

Wednesday, October 5th, 1955.

Los Angeles, California.

—0—

R. C. Sturgeon,
Official Reporter,
Parliament Buildings,
Toronto, Ontario.

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F I F T H D A Y

Los Angeles, California,
Wednesday, October 5th, 1955.
10:00 o'clock, a.m.

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The further proceedings of this Committee reconvened pursuant to adjournment.

The proceedings were held in the offices of the Air Pollution Foundation, Suite 801, Financial Centre Building, 704 South Spring Street, Los Angeles, California.

Mr. A. H. Cowling, Chairman,
 Presiding.

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PRESENT:

Messrs. Murdoch,
 Elliott,
 Brandon, Q.C.,
 Gordon,
 Thomas (Oshawa),

Hon. Mr. Kelly,

Dr. Frederick Evis (Secretary).

APPEARANCES:

Mr. H. A. Belyea,

Dr. Lauren B. Hitchcock, President and
General Manager,
Air Pollution Founda-
tion.

Mr. W. L. Faith, Vice-President and
Chief Engineer.

Dr. Neiburger, Senior Meteorologist,
Air Pollution Founda-
tion.

Dr. N. A. Renzetti, Senior Physicist,
Air Pollution Founda-
tion.

- - - - -

D R . L A U R E N B . H I T C H C O C K ,

President and General Manager, Air Pollution Foundation,
appeared before the Committee, but not being sworn,
deposes and says:

BY THE CHAIRMAN:

Q. Doctor Hitchcock, would you proceed, in
your own way?

A. Mr. Chairman and gentlemen, I would like
to give the members a little background of the
Foundation.

In this brochure, you will find basic
information about the Foundation. It is nearly

one year old, but it tells about the organization, how it started, and how it is supported, and its contributors, and that sort of information. It is all contained in the brochure.

We are an independent, non-political, and non-profit, fact-finding organization set up by civic leaders to assist the air pollution district and the community, by getting the facts about the problem, and helping to develop remedies, and to stimulate others to do so. As in the case of the automobile industry, I think we were helpful in getting them well started on remedies for the exhaust problem.

BY MR. BRANDON, Q.C.:

Q. What is your basis for support?

A. We solicit contributions in the community, often going further out into the country, railroads, hotels, and similar organizations.

Q. Industry generally?

A. Yes.

Q. And individual contributions?

A. Individuals are welcome to contribute. So far, we have made no approach to individuals, but rather to businesses, banking associations, clearing houses, department stores, Chambers of Commerce, and so forth.

Q. What about municipal, state and Federal

support?

A. With regard to government funds: the first is in connection with devices of service contracts into which we entered, to perform certain jobs for the county, and we wrote over \$300,000 worth of such contracts. It is the same with --

Q. Would you illustrate what you mean by a "service contract"?

A. Among these contracts, for example, we undertook to perform certain studies and measurements and fact-finding about the problems, and render reports to the county, and were working for them to supplement the work which their own laboratories were not equipped to do.

For political reasons, objections began to be raised early this year from certain people who suspected that we were either becoming the hand maiden of industry, or a "front" for selfish interests. At any rate, enough hue and cry was raised, so that the political response to this, even though the charges were entirely unfounded, led the county officials not to renew such service contracts this year.

That opposition has become better known and better understood, and I think by 99.5 percent.,

we are accepted for what we are, including by government officials.

Q. Do you receive grants now, municipal, state, or Federal?

A. No. Independently. It is interesting to find that all levels of government have arrived at about the same policy.

The Federal government recently appropriated \$1,190,000 to the Public Health Services, and to administer the pollution services.

BY HON. MR. KELLY:

Q. That is for the entire country?

A. Yes. Contained in the new Bill, called the "Kuchel Bill, No. S-928", which was passed in June, which authorized the appropriation up to \$5 million per year for five years, but provided no means of applying it to any particular locality.

The Budget Bureau cut a \$4 million-budget to \$1,190,000, which eliminated most of the scientific and engineering projects recommended.

Q. Coming to state government; what does it do?

A. The state government has just begun a separate air-pollution work to a very moderate degree. In the past Session, concluded only a few months ago, they appropriated about \$225,000 to the State Health

Department.

Q. That would be in the nature of 1 to 20, Federal and state?

A. Yes, that is the State Health Department.

Q. Their appropriation -- or the provision to introduce the appropriation, would be about \$20 Federally, and \$1.00 state? Would that be right?

A. There was no such restriction. It just happened as an appropriation. It is of no significance.

Q. It is not?

A. None whatsoever. The amount to which the Budget Bureau cut the Federal funds was arrived at by "crystal ball" methods.

Q. To what proportion would it work out, or what was the indication of the proportion to which it would work out between the Federal and state governments?

MR. FAITH: I think that from the \$1 million of Federal funds, less than \$100,000 was put into the project in California.

MR. THOMAS (Oshawa): And the remainder went to other states?

MR. FAITH: Yes, the state is probably putting up more money than the Federal, in our state.

DR. HITCHCOCK: Yes, the state appropriated

about \$100,000 for the air-pollution research through its health studies, but those funds were authorized to the University of California, Engineering Department, to carry on basic research.

HON. MR. KELLY: What have we got, Doctor Evis?

DOCTOR EVIS (Secretary): I do not know exactly the figures on research. I do not think there is too much being done.

THE CHAIRMAN: There certainly is not anything like that.

DOCTOR EVIS (Secretary): I was thinking about university research.

HON. MR. KELLY: Of course, we have provincial grants for that purpose.

DOCTOR EVIS (Secretary): It is possible that some of the provincial grants to the university got into Professor Allcut's department, but I do not know the proportion.

THE WITNESS: The funds which might have been made available to this Foundation are decided as a matter of policy at various levels of government that they should not be given to us, because we have not our own laboratory. But under the contract, every institution, anywhere in the country, -- we are not

restricted in any way by political reasons, in getting the work done, and we have been doing it in that way-- so the government says, "We contend we should not grant money to this Foundation, but if the Foundation would advocate that such-and-such be done by the University of California, or the California Tech., or the University of Southern California, the government will receive that recommendation and grant directly to the group which will do the work." So the Foundation is in the position of advocating or advising that certain work be done, and we will receive the same results, but perhaps not quite to the same extent, but we are giving the end results with government funds.

In the meantime, we are spending our own private funds which this year will be about \$600,000, and next year it will be \$750,000, which is all privately donated.

The contributors have no rights or privileges by reason of their donations, other than to help the cause, and receive copies of our reports.

BY THE CHAIRMAN:

Q. What was the size of the contributions?
Where do they start?

A. The highest industrial contribution was

\$200,000. That is from an Association, not just one particular firm. It comprises the companies on the West Coast, and represents about 50 independent donors.

Q. Do you have anybody out seeing "Joe Brown's factory"; about a contribution?

A. Not quite that way. The primary job of our trustees is to see that the funds are raised. They expect the scientific staff here to do the job, and they will provide the sinews of war.

They have set up a Finance Committee, of the trustees, and the Chairman enlists his fellows outside, for instance, in the steel business, he will look to the representative of the steel industry on the Finance Committee, to solicit the steel companies, and the bankers will be looked upon to line up the other bankers.

Q. These are all voluntary?

A. Yes.

Q. They do not get any pay for that?

A. No. We did have a public-relations fellow, who has had quite a bit of experience in charity campaigns, supporting the Symphony, and community drives, and he gives us a hand now and then as, for instance, the names in the hotel group who should be approached.

Q. You say that your budget for 1956 will be three-quarters of a million dollars?

A. Yes. We are beginning to receive contributions from national corporations, such as the Dupont Company, and the Ethyl Corporation, and the municipal Chambers of Commerce are considering coming in. Also the Carbide Company, and other companies.

The next largest single contributing group is the motor manufacturers. The Automobile Manufacturers' Association contributes \$100,000 a year, and that might be increased.

Q. You do not mind these questions, as we go along?

A. No, not at all.

Q. Have the motor manufacturers actually discovered something which will eliminate or greatly reduce the exhaust fumes? Have they been able to do that?

A. Mind you, they have admitted they have a job to do as of twelve months ago. Now, several large motor companies, which are highly competitive, are getting together on a common problem in the industry, which will take a little time. To get the specific project started, takes a little time also, so now, at the end of twelve months, they are very active in the way

of engineering research work, endeavouring to develop a gadget, and they have made good progress in a short time -- we have seen the work in the laboratory -- and they have reduced the loss from unburned fuel in an engine, which may have the effect of cutting the waste fuel from automobile operation, by 50 percent. If the devices which they are developing, can be fully tested, perhaps they may have them ready for the public, both on new cars, and to be installed on present cars, by January, 1958.

MR. FAITH: To put them on the 1958 models, they will have to have them by January, 1957.

BY THE CHAIRMAN:

Q. That is roughly only about a year?

A. Yes.

BY MR. THOMAS (Oshawa):

Q. Would the installation of that mechanism have the effect of conserving gasoline?

A. There are four different stages of a car's operation during which gasoline is lost, and the most important of the four is deceleration. They have learned quite definitely that about 60 percent. of the total fuel lost, is lost by deceleration.

BY THE CHAIRMAN:

Q. That is, when you take your foot off the

gas?

A. That is right, and the engine pumps gasoline through for a few seconds, and there is quite a loss. So they are directing their remedial devices at that part of it. Whether such devices will cut the gasoline losses in half we do not know yet. We do not know really how much this will reduce smog. It is assumed that cutting the hydrocarbon will have an equivalent effect on smog. There is a good deal of evidence that that presumption may be more or less good.

Q. While we are on this point, do you feel with all the technical and scientific studies that the exhaust fumes are large contributors to air pollution in your area?

A. Yes. We feel there is very little difference between "air pollution" and "smog". It may not be obvious for the moment, but let us say "Air pollution".

Q. That covers the whole picture?

A. Yes.

Q. Could you say what percentage of the air pollution --

A. A great deal of intelligent investigation has been done on the amount of pollution which comes from outside. In regard to automobile exhaust, and

bus exhaust, it is estimated that something like 45 or 50 percent. of what we consider to be total air pollution, comes from motor vehicles.

Q. That is good information. That is something the average motor car driver can understand and appreciate. You say about 50 percent.?

A. Roughly, yes.

Q. The cars and buses contribute 50 percent. of the total air pollution in the area --

A. Let me explain the use of that figure. That is 50 percent. of what we consider important pollution. We have included water vapour which comes from stacks, and we have included carbon dioxide, and carbon monoxide. It is estimated there may be from 6,000 to 10,000 tons per day of carbon monoxide released, as a result of all activities by traffic, and so on, but we have never been able to find any concentration of carbon monoxide anywhere near the minimum toxic level, in other words, about 40 parts to the million is about as high as we have found it, and that is quite unusual, and is far short of the minimum level.

Q. It is not poisonous -- up to now, anyway?

A. Under our conditions, it apparently dissipates, and disappears. We cannot find any evidence

of carbon monoxide that is a harmful factor in our atmosphere.

BY DOCTOR EVIS (Secretary):

Q. Would that not be because of your highly oxydized atmosphere here?

A. We do not know whether it blows away, that is, wafts away, or is converted to carbon dioxide, or really what happens to it.

Q. And you have included in that -- what?

A. We have included carbon dioxide. Although the evidence indicates the total is much larger, we cannot find any evidence at all that it is a factor, so it comes down to the unburned fuel, dirt, oxide of sulphur, and oxide of nitrogen, as being the principal pollutants with which we have to contend, and it was estimated there was a total of around 3,300 tons a day from all sources.

MR. FAITH: We have gone up to 3,700 now.

THE WITNESS: As I say, 45 percent. or 50 percent. of that is attributable to motor vehicle operation.

And of the balance -- and this is very rough -- certainly not over 20 percent. from the oil industry operations, which includes evaporation, losses of fuel, and their own stack emissions.

Then, an additional 10 percent. from miscellaneous industries, which brings you up to 80 percent., and the remaining 20 percent. is composed largely of rubbish burning and emissions from home fuel burning, fuel oil and gas, which adds a little pollution contribution -- not very much individually, but collectively it amounts to something.

It is not perfect combustion at all, but with natural gas you have better combustion than with coal, and with fuel oil you have better combustion than with coal, but we think that most of this pollution comes from these various combustion processes.

---Whereupon a short recess was had.

---Upon resuming.

BY HON. MR. KELLY:

Q. Tell me this, Doctor Hitchcock; you know of the Sudbury area, with the Nickel company?

A. I have been there, yes.

Q. You remember the old roasting ground where they roasted everything. There are stacks there I think 400 feet high, and they were erected from the standpoint of getting rid of the sulphur fumes.

Do you know if a 400-foot stack^{here} would suffice to diffuse the fumes sufficiently so you would not have

that trouble?

A. Our experience in Los Angeles would indicate that stack height is less significant under our peculiar conditions than in most areas. It may at times be helpful here, but you would not get as much benefit the year around. Is that not right, Doctor Neiburger?

DOCTOR NEIBURGER: Stack height is effective so far as the local single source is concerned, in that it enables you to get a certain distance down before it is mixed on the ground, so if you have a plant which is emitting a high concentration, it is very desirable to have a high stack, so it will be carried down for some distance, before it gets to the ground.

Our main complaint is with respect to the local sources and general sources. What happens on occasion down town has nothing to do with a specific local condition.

BY HON. MR. KELLY:

Q. I wonder if you had a place here where a high stack was installed, which cleaned up the previous situation?

A. Our conditions are somewhat unique in that we have thousands of stacks in the basin -- which is roughly 35 or 40 miles one way, and 50 miles the other

way -- but with such a large area, if you had higher stacks on a single source, you would perhaps, on the average, disperse the emissions to a greater distance, but you would get it from the other stacks, so in the whole basin the high stacks will not have much effect for a distance of 30 or 40 miles.

Q. And especially with the mountain range behind you?

A. Yes. In Sudbury, you are speaking about an isolated source, and, as far as I know, you do not have comparable atmospheric stagnation. You have normal winds and perhaps you do not have much temperature conversions up there, and there you find an optimum level.

You cannot solve air-pollution problems with higher stacks; you may disperse the solution sufficiently so that by the time it reaches the ground, as Doctor Neiburger said, the pollution does not hurt anybody.

But you cannot rely on that. You still have to make sample tests.

The Kaiser people out at Fontana have a special stack problem, being 50 miles from here, and the prevailing winds being from the west.

BY DOCTOR EVIS (Secretary):

Q. We had planned to go there Saturday, but I had a call saying we could not go in, as the pickets would not let us through their lines.

A. They can dissipate their smoke over a larger area, by having higher stacks, but that is not the logical answer.

By putting on an electronic precipitator device, the effect has been really dramatic, there is almost no visible emissions coming out. They have a programme where they are planning on putting on an electronic precipitator on each of the nine stacks, with the accessory equipment. The first installation cost about \$1 million, but the subsequent ones will not cost that much. I have not heard what the total cost for the nine stacks will be, but I have heard it said it will amount to \$3 million or \$4 million, and perhaps it may be more.

That pretty well solves their problem, I think.

They also have a staff of chemists and agricultural sample plots and test plants, and so on, ranging around a radius of miles from their plant, to see what harm is being produced on the crops.

BY HON. MR. KELLY:

Q. They have a similar problem up around Sudbury.

A. Our cement plant, farther east in the basin, produces a very visible deposit of fine cement dust for some miles around the plant. Sometimes the farmers and other people think they are getting harmful

effects from very little visible evidence of dust, and what-not, and they get a somewhat exaggerated impression. They attribute all their ills to that; in some cases, it is justified, and in other cases it is not.

So the only thing to do is to get a plant pathologist out there to test it.

BY MR. ELLIOTT:

Q. You have the motor cars the same as we have. What do you feel in this area to be their contribution to the smog problem?

THE CHAIRMAN: 50 percent.

THE WITNESS: Yes. To what extent that is actually to blame for the qualities of air pollution, or what we call "smog" I cannot say. We do not know what the compounds are, but we know that something, as a consequence of air pollution, damages plants, and forms ozone.

BY MR. ELLIOTT:

Q. The one we have is a little different. We have longer winters up there, and we heat our homes for an average of eight months per year, and up to 1945, they were using about 90 percent. or 95 percent. coal. Now it has gone to the very opposite, it is from 80 percent. to 95 percent. oil.

A. Oh, is it?

Q. Yes. So that means instead of getting coal smoke, we are getting no coal smoke at all, but is this gas from the oil not more dangerous? Have you any idea on that?

A. Obviously, it is cleaner.

THE CHAIRMAN: You had better include natural gas in that.

BY MR. ELLIOTT:

Q. There is not so much yet. There may be in the next few years.

A. They burn no coal here. It is all a gasoline and petroleum economy. We burn fuel oil and natural gas, and gasoline.

Your question is, what harmful emissions come from the burning of fuel oil? I do not know that I can give you a very good figure on the tonnage of pollution from burning fuel oil. That is one thing on which we have not much data, and we require more data and more testing, but qualitatively, from the burning of fuel oil, we get the oxide of sulphur, and we get ash. There is ash in the fuel oil, not as much as coal, but it contains a great deal of titanium, and beryllium, and metallic oxides. So what? We do not know what the effect will be. Some

say the oxidation of catalyts, and some say something else. Whether it will have any physiological effect, we do not know as yet.

We do get a little soot from burning fuel oil, and depending on the sufficiency of the various burners, you may get a percentage of partially burned or unburned fuel.

MR. FAITH: Do you want to include oxide combustion?

THE WITNESS: In all combustion, you get oxide of nitrogen, which is formed from oxygen and nitrogen in the air going through the heating zone, enough of that compound to form a considerable quantity of nitrous oxide. That is the method by which we would fix the oxide of nitrogen.

BY MR. ELLIOTT:

Q. There is a problem with us in connection with the use of fuel oil for heating the homes, and using the gravity system. They feel they get a smog in the house from the oil. Their windows will go oily. Is that just imagination, or is it a fact? I have heard it quite frequently.

A. I have used fuel oil in the home in which I have lived for, roughly, fifteen years, and I have never seen any evidence of it myself, and it would be

hard for me to imagine how that could be, unless you have a very defective installation.

Q. With the installation 100 percent. efficient, they feel they get a great deal of air pollution in the house.

A. Well, people do get a lot of ideas.

Q. I am in the contracting business, building houses, and we have that complaint coming from customers continually.

A. I know of no evidence of it.

MR. GORDON: I have used it for five years, and I have not noticed anything.

BY HON. MR. KELLY:

Q. I do not quite follow you on this oxide of nitrogen.

A. That is a very important point.

BY MR. BRANDON, Q.C.:

Q. I think you can notice a certain odour.

A. That is only stack gases entering the house from the street. I have heard this for years, but I doubt if there is any evidence of it.

BY MR. ELLIOTT;

Q. You have heard of the same problem?

A. Every time human beings make a change, they attribute everything that happens after that to that

particular change.

At one time, I was endeavouring to sell a new type of toilet soap, and one of the users broke out in a rash, and said the soap was no good, and they were trying to sue Colgates, and an investigation showed that the person had eaten a lot of strawberries the day before.

Q. We have the same condition as you have. Our homes are not our big problem, but it is the industries. We have one of the biggest steel companies in the world, in Hamilton -- that is my own home town -- at least, it is the biggest in Canada. They used to make about half a million tons per year, and used about 500,000 tons of coal. Now they are making over a million tons of steel with less than 100,000 tons of coal. They have cut their consumption away down. Yet, from the mountain area, you can see a terrific smog in and around that plant, even with the burning of oil and other fuels, and they have almost eliminated the use of coal.

A. How do you attribute it to that plant?

BY MR. BRANDON, Q.C.:

Q. Some is attributable to their coke plant which they have there.

A. This business of solving the smog problem

by visual inspection is very dangerous. Your air moves back and forth and around an area, and it may hover over an area which includes a plant, so they say it all comes from that plant. It may, or it may not.

BY MR. ELLIOTT:

Q At one time, it had about fourteen steam engines puffing smoke around. Today, they have none, and yet the workers claim the fumes from the Diesels, which they cannot see, are more dangerous than the old smoke which they could see.

Is there any truth in that, or is that also simply imagination?

A. We have no evidence of that.

Q. You have no evidence to prove that the fumes from Diesels are not just as dangerous and injurious to health as from coal?

A. There being no evidence of which we know as to the effects on health from Diesel or coal smoke, we cannot say one is better than the other, or worse. It is mainly a matter of condensation.

Q. I am not trying to "put you on the spot". I am giving you some of the arguments I get from some of the people, and I wondered if you knew some of the answers, which would help me to clear this up when

talking to these people.

A. All I can say is that having examined that with some care, and looked for evidence of this matter, I could not find any evidence as to the relative health effects of normal coal-smoke pollution versus Diesel air pollution.

Q. So you feel that the exhaust from the Diesels is not as dangerous?

A. We do not know.

BY MR. BELYEA:

Q. Doctor Hitchcock, do they use number 1 or number 2 Diesel fuel in their truck engines? Have you any regulations with respect to having to use number 1 oil?

MR. FAITH: I think they use both. A lot of the smoke from Diesels is due to a low-grade fuel, but there is no requirement as to what fuel a man shall use. The only requirement is that he shall not have any smoke.

MR. BELYEA: I thought when they came into the city, they must use number 1 oil.

MR. FAITH: There is much less smoke from number 1.

BY MR. BRANDON, Q.C.:

Q. Is there any method of checking the density

of Diesel smoke from a truck, on the one hand, and checking the smoke from factories, on the other.

A. This is what I was about to try and express, that, first of all, the Air Pollution District -- the only basis by which we have control of Diesel smoke, as well as industrial smoke, is on the basis of the Ringleman chart. They emit a certain grade of grey smoke and by this colour chart, if the stack emits a Number 2 Ringelmann for more than three minutes in an hour, they can be cited. That is rather an empirical type of gauge.

The inspectors gain enough experience so they can look at a stack and see that it is clearly darker than one of these three shades of grey. They have white and black amongst the five colours, and that leaves three types of grey, and they can distinguish between them, as a matter of judgment, which they learn from experience.

BY MR. BRANDON, Q.C.:

Q. What about an inspector who may have some sort of defective eyesight?

A. He should not be an inspector. He is supposed to go to school and pass a test.

If you are spending some time with the A.P.C.D. people during your stay here, by all means

ask them.

They are beginning to secure some bits of data on the combustion of Diesel smoke. It varies a great deal, but they can begin to give you some idea of the quantity of emission. It will contain a very little carbon dioxide, and a little soot.

BY MR. BRANDON, Q.C.:

Q. Speaking in regard to Diesels generally; is it not true you find there is a continuous emission of smoke of some sort, and when they accelerate, it becomes much darker?

A. Yes. Sir Hugh Beaver, in charge of British Air Pollution investigation, was here recently, and he said they rely on Diesel engines in buses largely, and they have found if they have good discipline in regard to maintenance in their garages, they have been able to cut down the black smoke.

BY THE CHAIRMAN:

Q. Were you able to exchange some ideas of mutual interest?

A. We were.

Q. Did he think that California had anything comparable to the London smoke, or that of Edinburgh?

BY DOCTOR EVIS (Secretary):

Q. Would it be worth our while to take a trip

overseas?

THE WITNESS: No, I do not think we were in a position to compare, but as Doctor Neiburger has indicated, we have felt this London condition is largely traceable to soft coal.

BY MR. THOMAS (Oshawa):

Q. Ours is an oil economy. In Great Britain, it is a much older type of industry which depends on coal?

A. Yes.

BY THE CHAIRMAN:

Q. What was Sir Hugh here for?

A. To do the same thing you are doing. He was making a tour of principal cities in the country where they have similar problems.

The most important thing I think he said was that he felt -- he was talking about the philosophy of air pollution control, and I, for the sake of argument, chose the optimistic view that you cannot expect governments to regulate, and have a policeman and a chemist standing over every exhaust stack in a huge industry, and, therefore. I argued must he not rely on voluntary education that once the public understands what the problem is, they must rely on voluntary co-operation and decency and civic

pride.

He said he had heard that for years, and he said, "The only thing which will do a particle of good is regulations." He said, "You can talk yourselves blue in the face, but the only thing to do is --"

BY THE CHAIRMAN:

Q. "put it on the line"?

A. Yes, "put it on the line".

Q. That is an interesting thing to get from him, because he has been associated with this work for many, many years.

A. Yes. He is a very able man.

Their programme is for fifteen years, and to gradually change to coke, but they have not the proper grates in many of the homes as yet, so it is a question of providing the facilities and equipment, and for many years they will need a government subsidy whereby the average householder will put up 25 cents and 75 cents will come from the government.

MR. FAITH: May I make a few remarks in regard to this Diesel thing, because we always get into these Diesel discussions. It comes in on a tonnage basis which is a very small proportion of the total. We have definite figures showing that the smoke which goes into the air -- the aerosols -- amounts to only

about two tons per day from Diesels out of a total of 200 tons going into the atmosphere. In the case of oxides of nitrogen, it is estimated we get about three tons per day out of a total of between 700 and 1000 tons, and in the case of sulphur dioxide, we estimate less than one ton goes into the atmosphere, out of a total of 500 tons. That goes on right down the line, and is hardly worth mentioning when the total amount of material which goes into the air from Diesels is really infinitesimal, as compared with a like material coming from other sources.

Of the aerosols which go into the air -- in other words, the smoke particles -- about 65 percent. it is estimated come from backyard burning of rubbish.

In the case of hydrocarbons going into the air, about 1000 tons goes into the atmosphere, out of a total of about 1500 tons. So we thinks it puts us into rather a preferred position.

THE CHAIRMAN: We do not have the burning of garbage in Ontario.

MR. FAITH: This is not garbage. It is paper, and tree clippings.

THE WITNESS: What about your lumber mills?

THE CHAIRMAN: We do not have them at all.

MR. FAITH: We get into a discussion on Diesels,

when, as a matter of fact, it is so small as to be almost negligible.

THE WITNESS: I doubt if your Diesel problem in Toronto is any greater than it is here. It is a very small part of the problem here.

THE CHAIRMAN: That is very good information. As I said, that is the thing we are working toward now, and with the scientific data available, I think we can hope that Diesels will become a very insignificant part of the total.

MR. FAITH: From the total air pollution standpoint.

THE WITNESS: In other words, we have not enough ammunition. Let us not waste it on the small hole of the telescope, but use it on the big end.

BY MR. ELLIOTT:

Q. According to the impression I have heard from England, in the London area where they have had terrific smog in the last two or three years, they claim -- and this may be a little bit of imagination -- that there have been five or six oil refineries built on the Thames estuary, and until they built them, they did not have this problem, but since then, this smoke problem has come up.

MR. FAITH: I have heard a great deal of that.

THE WITNESS: Have you read the Beaver report issued a few months ago?

DOCTOR EVIS (Secretary): Not yet.

THE WITNESS: It is not long, and it is a very good job.

BY MR. ELLIOTT:

Q. You have not heard of that condition in London?

A. We have read everything that has been published in the London area.

Q. Do you find that the oil refineries have had anything to do with it?

A. No evidence at all.

DOCTOR NEIBURGER: All we have seen is the data on the SO_2 . They say this comes from the burning of coal in the town of London. Whether the SO_2 meteorological conditions they have in the London district affects it, we do not know.

THE WITNESS: They have had an awful lot of smoke for an awful lot of years before.

MR. ELLIOTT: It never reached a point before where people laid down on the sidewalk, and choked to death.

THE WITNESS: As they point out in the Beaver report, the first Anti-Seacoal Act was passed 300 years

ago in London. I think they do have serious air pollution at times, and have had for a good many years, and the Beaver report indicates they have put the best brains and students they have on it, but their problem, I think, is largely due to the burning of soft coal.

MR. BELYEA: There is an interesting thing I have been trying to find out about. They have burned a tremendous amount of soft coal for years, and very recently they have gone into the steam generating plants, which burn a tremendous amount of soft coal. I have been told that the higher temperature combustion of the steam generating plant produces sulphur dioxide, whereas the lower temperatures in the homes do not.

It would be interesting to get the answer to that one.

MR. FAITH: It is a little different, I would suspect. A little sulphur in the coal eventually gets into the air as sulphur dioxide.

THE WITNESS: The only reason you did not get it would be you did not burn all the coal, and more or less sulphur remained there.

MR. BELYEA: Would that vary the sulphur going into the ash?

MR. FAITH: I doubt if it does, because the difference between high-burning and low-burning is not large. There may be some difference.

BY THE CHAIRMAN:

Q. Doctor Hitchcock, tell me this; -- it may be a far-fetched example; but you have a great many aircraft around this Los Angeles area --

A. And a great deal of testing, too.

Q. Do you feel they are making any contribution to your problem here?

A. I do not know. I have wondered about that. Preliminary feelers have indicated it will probably turn out like the Diesels.

Q. There is not much known about it?

A. No. We really do not know about it. But, of course, we have nothing like the number of engines overhead as we have on the ground.

Q. It would only be when landing and taking off?

A. Yes. I think more would come from testing the engines on the blocks here. We have rather large aviation industry here, in fact, about one-quarter of our industrial workers are working in the aviation field.

Q. Is it that large?

A. Yes, about one-quarter.

We have five minutes before we want to show you some pictures, which will tell you a great deal

about our problem.

Two questions were asked which I would like to answer. First, about the nitrogen oxides. That is a phase of the city air pollution which is only just beginning to be given attention.

We find that all combustion results in the formation of a certain amount of nitrogen oxide, that is, the inert nitrogen in the air we breathe, and the inert oxide which, combined, forms very active, chemically, nitrogen oxides, which appear to play an important role in our problem, in some way we do not understand as yet.

The reaction of the hydrocarbons and the gasoline fumes would produce high irritation, and plant-damaging agents. This is not fully proven out yet, but the evidence certainly suggests that takes place, and the role of nitrogen oxides in our air pollution problem does appear to be important, even though we have not fully resolved the chemistry.

So if what is indicated --

BY HON. MR. KELLY:

Q. That would seem to be the meat of the problem?

A. It is apparently an important pollutant.

Q. That irritates everybody?

A. Yes. These nitrogen oxides seem to permit the formation of irritating and harmful products of our air pollution.

Now, if that is the case, it would indicate we have to develop consideration for nitrogen oxide. A man does not have any knowledge as to how to do it, but it suggests he may have to develop a gadget to put in stacks, or gas pipes, which would decompose, or in some way restrict the nitrus oxides.

If we could remove all the nitrogen oxides from our combustion sources, it may have a big effect in eliminating air pollution, to a large extent.

We would still have air pollution, but a great deal of it might be prevented.

So far, no nitrogen oxides have come into the picture to deserve attention.

The other point about which I wish to speak is this:

For one and one-half years, we have been at grips with this problem, but here, as anywhere else, to deal with the air pollution problem, you must know the concentration of various pollutants day in and day out; what the habits are, and how the concentration arises in certain areas of the city.

Until we have such information, we do not

see how you can intelligently deal with control, any more than a patient could go to a physician with a new malady, and have it correctly diagnosed. The physician would first have to take blood samples, urine samples, the pulse, and so on and so on. The same thing is true with air pollution.

What the public does not understand is that air-pollution "doctors" cannot diagnose nor prescribe until they have more information. But people are so impatient; they want to be cured tomorrow, or today preferably. We tell them we do not know as yet, and we have no remedy as yet.

BY MR. BELYEA:

Q. I do not think the public just appreciates what "smog" is.

A. We will show you some pictures in a moment.

Q. During the heavy smog period, what are the effects on some of the people, and what percentage are bothered with it? What percentage, in a heavy smog, would have eye irritation, for example?

A. A large percentage.

MR. FAITH: I would say over 50 percent. It affects different people in different ways. Some have high irritation; some have eyes running, and some people cough.

BY DOCTOR EVIS (Secretary):

Q. Does anybody get nauseated?

A. Yes. But I think a great deal of it is suggestive. They become nauseated and get headaches.

BY MR. THOMAS (Oshawa):

Q. Before we go, there is one question I would like to ask. Does the Air Pollution Foundation operate in other states?

A. No, but we are sending copies of our technical reports to libraries, and universities all over.

Q. Further to that question; with rigid enforcement of the regulations in this particular area, do you think there might be a tendency to discourage the location of industry?

A. It has not yet. In spite of all the smog we have, this community is continuing to grow at the highest rate of any community in the world. I think it is 18 percent.

DOCTOR EVIS (Secretary): Is it not a fact that your Chamber of Commerce recommended that industry be discouraged, if it was of a type which could not be controlled?

THE WITNESS: Right.

BY DOCTOR EVIS (Secretary):

Q. I was hoping you might say something about

the meteorological effects, for instance, how much does the intensity of the sun contribute to this?

A. Oh, a good deal.

---Whereupon a short recess was had.

---Upon resuming.

THE WITNESS: In regard to the suggestion about monitoring the pollutants:

There you run into the question of not having sufficient equipment to measure these pollutants. One thing this Foundation has done in the past year is to assist in the development of such devices. We have several such pieces of equipment well along toward perfection for measuring hydrocarbon, carbon monoxide, and the quality of the air called "oxidates".

BY THE CHAIRMAN:

Q. The Ringleman Chart is the main one for measuring smoke?

A. Speaking merely of the opacity of the black smoke. That is still used, but all of us here are striving to develop a more scientific way of measuring the density of smoke.

Q. It is rather amazing when we think that all across the world, people interested in air pollution use this really old-fashioned chart. Is it for want of a better device?

A. They have a smoke-control electronic device for putting on stacks, where you can read the opacity on a meter, but that does not meet the requirements of an inspector who may be a half a mile away, but I think we will get it eventually.

Q. Do you ever have your time of emission of smoke longer than three minutes?

A. Up to now, it has been three minutes.

Q. Are you considering reducing that to one minute?

A. That is up to the city.

Q. Has that been up for discussion?

A. Yes, I believe so.

DOCTOR EVIS (Secretary): That will be taken up this afternoon, Mr. Chairman.

- - - -

---Motion picture entitled "Smog" exhibited to the Committee.

THE WITNESS: A couple of weeks ago, we put in a regulation whereby you could only burn incinerators on Saturdays and Sunday mornings. Since then, they have arrived at the decision that the best time to permit burning, when smog conditions are forecast, inasmuch as the smog appears fairly early in the

mornings -- and when smog is forecast, burning is prohibited in the morning, but has been permitted between four o'clock and eight o'clock, p.m.

BY DOCTOR EVIS (Secretary):

Q. Why do they allow burning at all?

A. Because they have no other place to put it. They have garbage collections, but they do not collect combustible material. The city of Los Angeles is now developing a collection system, but it has not been completed as yet.

MR. FAITH: The items in the incinerators include refuse from the gardens, tin cans and other non-combustibles. They are also collected.

BY MR. THOMAS (Oshawa):

Q. I would imagine the geography would be very important in regard to air pollution?

A. And the weather conditions, yes.

MR. FAITH: Another thing is the fact that our inversions occur very frequently in the summer and fall, much more than in the winter.

THE CHAIRMAN: Is your garbage collected by the city or by private authority? Is it the city's responsibility?

BY MR. BRANDON, Q.C.:

Q. Does the lack of rain out here detract from

the smog condition?

A. We do have rain, but we do not have it six months of the year.

Q. When you do have it --

A. When we do have it, the weather is sufficiently unstable, so we have a pretty high concentration.

- - - - -

---Motion picture entitled "Smog Men at Work", exhibited to the Committee.

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STATISTICS

1. Two cars per family, plus the industry necessary to support them.

2. California has spent approximately \$25,000,000 on gasoline-vapour control.

3. Nine recording instruments have been adopted by the Foundation.

4. Considerable work has been done at the California Institute of Technology.

5. The Stamford Research Institute at Pasadena has also done considerable work.

6. Eyes are not irritated at the same time and place that plants are damaged.

7. Re: The Los Angeles Laboratory.

700 cubic feet of air condensed into large drops of condensation,

8. Three-one hundredths of cubic centimeters of hydrocarbons.

9. In re the Southwest Research Institute, at San Antonio, Texas.

At the end of 10,000 miles, further development of the mufflers has become necessary.

10. In re: The Midwest Research Institute, Kansas City, and the Air Pollution Control District Laboratory at Los Angeles.

11. Los Angeles and Detroit engineers working on devices, which work must be continued.

Studies are also being made at Chicago, Kansas City, San Antonio, Los Angeles and Detroit.

12. Re Incinerators.

13. Re the Mattel Chemical Foundation, Columbus, Ohio.

14. In regard to the Aldehydes:

Organic gases are the result of incineration. One million pounds every twenty-four hours, of smoke, dirt, dust and noxious gases, produce millions of tiny particles just the right size to enter your lungs.

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---Whereupon the further proceedings of this Committee adjourned at 12:35 o'clock p.m., until this afternoon.

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A F T E R N O O N S E S S I O N

Los Angeles, California,
Wednesday, October 5th, 1955,
2:00 o'clock, p.m.

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The further proceedings of this Committee reconvened at 434 South San Pedro Street, in the city of Los Angeles, State of California, at the offices of the Air Pollution Control District.

Mr. A. H. Cowling, Chairman,
Presiding.

PRESENT :

Messrs. Brandon, Q.C.,
Elliott,
Murdoch,
Gordon,
Thomas (Oshawa)

Hon. Mr. Kelly,

Dr. Frederick Evis (Secretary).

APPEARANCES:

Mr. S. S. Griswold, Director, A.P.C.D.

Mr. Pratch, Assistant Director,
 A.P.C.D.

Mr. W. J. Mellor, Senior Information
Officer, A.P.C.D.

Mr. Martin Brower, Assistant Information
Officer, A.P.C.D.

Mr. A. A. Atkisson, Public Services Officer,
A.P.C.D.

Dr. Ruth A. Bobrov,

Dr. Paul Mader.

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MR. ATKISSON: Gentlemen, on behalf of the Air Pollution Control Committee, let me welcome you to our Headquarters. I am sorry to say that Mr. Griswold will be a little late. He is on a field tour, and probably will not be back until three o'clock or perhaps three-twenty.

I would like to introduce our people who are here. The programme which is outlined for you this afternoon is a very informal one. Doctor Evis advised you were interested particularly in things like crop damage, so we invited Doctor Bobrov.

MR. PRATCH: Would it be possible, Mr. Atkisson, to give them a brief resume of the programme beyond this afternoon?

MR. MELLOR: They have an agenda up until Saturday morning.

MR. ATKISSON: We thought we would give you a thumb-nail sketch of some of the things you will see in

the field. We do not want to tire you, but we have a number of slides and pictures of smog in the Los Angeles basin.

I thought I might summarize very briefly some of the things you will hear this afternoon. I am sure Doctor Hitchcock did a thorough job this morning.

I think, in effect, there are three major areas which should be considered in approaching the smog problem. One is that it must be defined, and the reasons for defining the problem is to bring about a realization of the research efforts which are being made.

Secondly, tests must be made to cope with the problem.

And, thirdly, we need the necessary administration to carry on the programme to combat the problem with which we are faced.

It is not easy to define "smog" in Los Angeles, and the causes thereof, but we consider there are four major symptoms of smog. The first, and perhaps the most annoying, is the eye-irritation property. About twenty days in the year, from January 1st, we have days with heavy material and eye irritation in the downtown district, and in the foot-hill

areas.

Then, there are some light days of eye irritation, which are not detected in some areas. There are some areas which have~~never~~ seen it, and there are many people in the areas of eye irritation who have never personally felt it at all. But there does seem to be quite a substantial number who are bothered with this eye irritation, and that is one of the properties we must combat.

Secondly, the second symptom is what is causing the crop damage. We know there are certain chemicals and contaminations which cause crop damage. Sulphur dioxide is a case in point. As opposed to that, there has been a type of crop damage in the Los Angeles basin which is caused by our general smog conditions. Doctor Bobrov will talk about that later, and there are several million dollars' damage about which we know, and a great deal more about which we probably do not know.

Certain crops are not grown in this county as they formerly were, because of the smog. We have heard the report that even citrus fruit has been affected in size and yield by smog -- or at least, it is supposed to be.

The third symptom is the reduction in

visibility, and this is the most readily apparent.

I might comment here briefly and say that in 1947 we had the poorest year as far as visibility was concerned. It was in that year the control programme of the District was established, and the following year -- or in 1949 -- we had the best year, as far as visibility was concerned since 1940.

Now things have become a little bit worse, and our visibility is about as good as it was in 1944. This is on the basis of observations made in the civic centre, which we think give us an accurate picture.

The next symptom is nuisances like odours, and this is noticeable where houses are located near a smoking stack.

These are the problems associated with smog, and they are important in that our objective is to clean up each of them, and we feel we have a programme to eliminate each of these symptoms, although it is obvious we have done a real job in eliminating some, more than in others.

I recently took a trip up to the northwestern states, and on that trip I saw more smoke stacks and detected more foul odours than I personally have seen in Los Angeles County in twelve years and a half.

I think we have probably done a good job in eliminating the nuisance symptom. We are now concerned with the other symptoms, the eye irritation, the reduced visibility and damage to crops.

Unlike other areas, such as Pittsburgh and London, our type of smog can hardly be called "smog", which is a contraction of "smoke" and "fog". The problem is to know just what is in Los Angeles County. There have been approximately fifty different materials which have been identified in our atmosphere. These roughly fall into two particular classes. On the one hand, the solids and liquids, known as "aerosols", and on the other hand there are the gases, most of which are invisible, and it is to these gases that primarily the finger is pointed as the cause of eye irritation, and the crop-damage properties, and smoke.

Today there would be some 4,400 tons of material in both classes in our atmosphere each day. As a result of the Control programme, we are preventing about 1,100 tons of material entering the air every twenty-four hours, which leaves a balance of, roughly, 3,300 tons. Breaking that down on the total tonnage basis, that works out pretty close to 2,000 tons, including nitrogen and sulphur

fumes from automobiles, and possibly another 500 tons from the refining industry, about 130 to 200 tons from rubbish burning, and the balance from industrial sources.

This has meant that we have to carry on a very industrious programme, particularly against the backyard incinerators, as well as the various categories of industry, and must devise some programme to meet each of these requirements.

In a way, we have two principal problems to fight, one based on the continuing growth of the county, and the necessity of forcing down the existing pollution level, far below the present figures.

Perhaps the most successful job has been the control of the growth of the county. I will not bother you with a list of the rules and regulations under which we operate, but suffice it to say that it gives authority to review and approve or reject all industrial activities in this County.

Just last week, there was denied some twenty million dollars worth of plants and different types of industry, and the Los Angeles Chamber of Commerce has now endorsed the programme we are pursuing, for instance, with certain types of industries which will

not be permitted to come into this County unless controlled with a high degree of efficiency.

We are looking at another angle, that is, the proposition that the County be zoned for industries, so that new plants can be located in those areas, and steps taken to accommodate them from an air-pollution point of view, and we have some very detailed knowledge of wind currents, and micrometeorological conditions throughout the County.

We have been continuing meteorological studies for the past three years, and we hope to wrap it up this year, and seek the legislation and municipal authority we need to carry on the programme.

As far as forcing down the existing level is concerned; we have a very potent weapon, and that is to adopt rules and regulations which have the full force and effect of state law. We have adopted several up to date. We have one which specifies the amount of particular matter which may be emitted from any source, and similar regulations which control the quantities of sulphur fumes and sulphur contamination into the atmosphere. This is aimed at one type of contamination, regardless of any industrial category.

Secondly, we have to draw up regulations

which deal with specific sources, so we have adopted regulations which require the petroleum industry to instal the closed roofs, and yesterday we adopted one which requires them to cover screen the oil and water separators, which previously had been open to the atmosphere, with a fairly substantial amount of hydrocarbons being thrown off from them.

That, in a nutshell, is the way the smog problem and the control programme looks today.

I hope Doctor Mader will not laugh at me, but one of the most important contaminations in our atmosphere is the hydrocarbon which is supposed to be the source of the eye-irritation properties of smog, and in order to make any kind of progress, it will be necessary to control the automobile exhaust with a high degree of efficiency.

It is difficult to relate these in terms of improvements. Certainly we felt that because of the problem posed by visibility, that the emission of matter like aerosols would have to be subject to more stringent control and for that reason we have adopted a regulation to ban rubbish burning, which will be completely effective in two years from last October 1st.

At the present time, all open burning of

any type is banned throughout the County, with very minor exceptions, such as the necessity for weed abatement, and so forth. We hope we may see some improvement in visibility, as well as some other benefits from the elimination of this type of contamination.

We have adopted these regulations, and are enforcing them, as can be shown from the fact that we have instituted better than 1,200 court actions against violators of the air regulations.

BY THE CHAIRMAN:

Q. This year?

A. Yes, that is since January 1st last.

BY MR. THOMAS (Oshawa):

Q. Can there be any appeal from those decisions?

A. Yes. There are three refineries which now have appeals filed before the Supreme Court against one enforcing action.

There is appeal procedure whereby firms can go before our Hearing Board, and ask for a variance from the law in order that they might have sufficient time to instal proper control equipment. It is obvious to us that to get the courts to levy fines does not clear the air, but by the acceleration of this constant pressure, we have seen some activity

from industry which we probably otherwise would not have seen.

I happened to be out in one area and met a plant manager of an industrial plant, and he said to me -- and we later checked it, and it is true -- that in the past six months he had been issued three tickets for the violation of one law or another, and the court had assessed total fines against him of \$12.50, but as a result his company had installed more than \$70,000 worth of air-control equipment, which raised their expenditure to \$4,000 per month for air-pollution equipment alone.

We know that is occurring, and we know that industry will speed up their own programmes, and we know that this year we have received more requests for control equipment than in any similar year.

We have tightened up our requirements, as far as new industrial plants are concerned, and in the last six months we have denied authority to about 500 to construct new plants.

That is where we stand today. We have perhaps the most aggressive programme which exists anywhere in the country, and at least in one regard, in our research field, we feel we have an organization which is without peer, and I know that Mr. Griswold,

if he were here, would say that the thing of which he is the most proud is the calibre of the research programme in this field.

There is no doubt that Los Angeles has smog, but this year it has been worse than in previous years, and it might be getting even worse next year, but, at the same time, we think we are dealing with it with the most complete knowledge that exists anywhere in the world.

We have taken more action than any other agency in the world, and we feel that at least we have some hope of restoring clean air, and probably some areas in the world, which are beginning to see the effects of smog, will find they are beneficiaries from some of the information we have acquired in this eight-year struggle.

Have you anything to add, Mr. Pratch, to these comments?

MR. PRATCH: No; as a matter of fact, I have learned a great deal.

MR. ATKISSON: There is one other factor and that is weather conditions, which makes this such a critical area, and you will be shown on the slides why these are important.

I am told we are the only city of any size

in the world which faces the particular weather problem that we do. On some 340 days a year, we have this inversion layer above us, and from 70 to 100 days we have an inversion layer lower than 1,500 feet, or even less, from the ground, and it is coupled with no wind movement, or very little, and it is on those days that we have smog.

On the days when we have a good wind movement, we would like you to look at Los Angeles, because it is a pretty good place to live in.

Are there any questions on this particular summarization? (No response).

If not, I would like to turn the meeting over to Mr. Brower, to carry on with the slides which he has brought with him.

MR. MELLOR: Mr. Brower will not take too long with the slides, he will just show them to you, with perhaps a few brief comments as he goes along.

MR. BROWER: We have a group here which may not be too pertinent.

SLIDE NO. I

This is what Mr. Atkisson was pointing out as our inversion layer.

SLIDE NO. II

This shows the height, but the fact is,

it was the inversion layer which gave us our first problem here, because many of the other cities and districts have decided they required the strict control activities, which we have here, but which, of course, may not be very necessary in many of the other areas of the world.

SLIDE III

These pictures were taken out in the San Fernando Valley at intervals of one-half hour. Instead of rising and dissipating into the open air, it spreads out, and as more industries are being added, we have more smog.

A great number of people say that they cannot see the mountains as they did, say, ten years ago.

SLIDE IV

Here is the view of typical smog conditions.

SLIDE V

This is a shot of our school, which you will see when you go to the laboratory, where we train inspectors to read smoke opacities.

SLIDE VI

This is our source-testing crew. We have to actually test the source itself.

SLIDE VII

This shows a lot of steam, and in that steam there are more gases, which the laboratories have analyzed.

SLIDE VIII

This is a plant you are going to visit tomorrow, the Bethlehem Steel, the largest in Los Angeles County. The smoke control we have there is concerned with the open hearth furnaces, which give out a certain amount of smoke and dust each day. With the electronic precipitator, the amount is cut down. There was a time when you could not drive past the plant without putting on your headlights.

SLIDE IX

This installation cost \$600,000, and collects up to 10 tons per day of dioxide which was going into the atmosphere. It is about 90 percent. efficient, and it took four years to engineer and build that.

SLIDE X

This is in the steel plant, another large steel mill on the left, and shows the work of the controls right after an expenditure of some \$600,000 for four electronic precipitators.

At one time, the United States Steel was

experimenting with higher tower smoke stacks. Now they are giving themselves shorter smoke stacks.

SLIDE XI

This is a plant in the Torrence area with pure oxides pouring out.

SLIDE XII

This shows the dirt which was collected, and which went through the bag house. The zinc oxides were collected, as shown in the reports at that time. This cost the foundry about \$455,000.

SLIDE XIII

That is the material collected.

SLIDE XIV

This shows them piling up the material, hoping to find something to do with it some day. If someone was to find a way of using it economically, it would be a real boon to the industry.

THE CHAIRMAN: Was that the stuff going into the air?

MR. BROWER: Yes. It was a solid zinc oxide.

SLIDE XV

These are some other types of control

equipment on grinding operations.

SLIDE XVI

This gives control of certain operations which give quite an odour, and apparently is a smoke problem.

These have temperatures of about 1400 degrees, and today New York city is doing some work in that regard.

SLIDE XVII

This is the first time we used as control equipment the water scrubber. We have many people coming and asking, "Why do you not wash it out?". We found that water was very inefficient.

With some industries, they tried to use it at a cost of from \$7,000 to \$10,000, but it has been so far not good enough to comply with our regulations.

SLIDE XVIII

This is a sulphur recovery plant in the Wellington area, which cost about \$1 million. But here sulphur is a valuable by-product, and they say that the \$1 million was returned back in the first year.

SLIDE XIX

This is the Union Oil plant, and hydrogen

sulphate is converted into pure sulphur, which is used for the manufacture of sulphuric acid. It is shipped out in drums, and is material which would have gone into the air as sulphur dioxide.

SLIDE XX

This one plant collects 120 tons a day of pure sulphur, and a total of about 420 tons a day of sulphur dioxide, which is being kept from the atmosphere from this plant, and the one out on Wilshire, and several others.

SLIDE XXI

This is a picture of a research laboratory, in connection with the oil refineries.

SLIDE XXII

This is one of our smokeless glares. All parties use glares to dissipate their emergency amount of gases, which must be dissipated.

We have two types of glares which control smoke. This is a steam injector glare for injecting steam which will cut down the smoke.

At one plant, they have burners which come in successfully, and have the effect of reducing or nullifying the smoke.

SLIDE XXIII

Vapours are a big part of our problem, especially those in connection with gasoline storage tanks. We gave them two years to put in floating roofs and different types of vapour recovery systems on their tanks. There are about 400 tanks affected, and they must be completed within two years at least. Under a section of our law, which was passed in 1953, they had to have this type of control. Otherwise, there would have been a tremendous amount of vapour which would have gone into the air from those tanks.

SLIDE XXIV

Mr. Atkisson said that we had a regulation passed to control the oil separators. This is one in Los Angeles County, but we had no way of controlling it until the refineries went ahead and got the equipment.

SLIDE XXV

The Union Oil has the floating roofs. It has until July of next year to have the separators, but these floating roofs with the vapour recovery system of full control were recently installed. This was aimed at getting rid of an extra 15 tons a day, but it cost a great deal of money.

SLIDE XXVI

Experimentation is still going on with the tank trucks. Vapours are disposed of, and the refineries are experimenting with vapour-return methods. The one at the top and the one on the right are used for returning vapours.

SLIDE XXVII

There is a device pushed into the machine. There are several limitations to this device. We will select the best devices, and will have a regulation by which all our stations will be equipped with these devices.

For instance, this one which has "aviation" on it, is affixed as they load the gasoline, and it becomes heavy and settles as the gasoline is lowered in the tanks. It is something which will give pressure and follow the load down.

BY MR. MURDOCH:

Q. Is there any value to the recovery of the vapours?

A. Yes, the greater percentage of them are actually turned back into liquid fuel. The remainder are combined in the fuel system, and it is used in that form. The vapour-recovery problem is one which gives value in return.

With the plant-control programme, there was something like \$8 million spent, and that has been repaid to the refinery because of the vapours saved.

SLIDE XXVIII

In this case, when they build these automobile storage tanks -- that is, fuel in underground tanks -- it is for vapour disposal. The method by which this will ultimately be handled is that when the fuel is discharged, there will be a closed system on the underground storage tank. When the tank is lowered, the return line will return the vapour to the truck, and when the truck is full, the return line will return it to the refinery, to be disposed of as they wish.

That is alright for a great many service stations, but we are experimenting with the County service stations, as far as the underground tanks is concerned.

We have 6,600 service stations in Los Angeles County.

SLIDE XXIX

This illustrates another phase of the problem with the automobiles.

SLIDE XXX

This is to show the people what is trying to be accomplished.

SLIDE XXXI

The automobile has about 7 percent. of the gasoline unburned. We get about 1,100 tons of unburned gasoline vapour going into the atmosphere each day.

Doctor Mader will probably tell you that just two weeks ago he was in Minneapolis, where he addressed the American Telephone Society on the type of fuel being used today.

Catalytically-cracked fuel is very important. Therefore, in our laboratory, which you will probably not have the opportunity of seeing, we are testing fuel and engines.

We have the first laboratory of that type in the world, and it determines what part the automobile actually plays in the picture, and what might be done to control the automobile, and if there are any devices now available which can do the job.

It is possible we are getting to a problem, for which we will have to go to the automobile industry to find a solution. We cannot develop the

devices ourselves, but we must wait for the development, and we will have something someday, soon, we hope.

SLIDE XXXII

Mr. Atkisson told you about rubbish burning. The city of Los Angeles has no rubbish-collection system. Instead, we try to show the citizens that the way to dispose of it is the way they are doing in Burbank.

SLIDE XXXIII

One day this city will look like this.

MR. MELLOR: I think I did not give "Marty" (Mr. Brower) the proper kind of introduction. His last name is "Brower", and we are proud of him because he came to the District as an inspector, and a little later on became a technical writer for the District, and now he is the Information Assistant, since coming in from the field as an inspector.

We work together on the educational problem. He gives many talks throughout the County, and I think is one of the best-informed men we have in the District, and we are very proud of him, and we feel that we have, in him, a young man who will "go places".

So we are always glad to hear from "Marty" (Mr. Brower).

Now, Mr. Griswold has not arrived as yet, but he will be here, and if it is convenient now, we might have some pictures for Colliers. We have a gentleman in the back of the room, Mr. James Prindle, who will take the pictures, and I think he is going to write an article for publication in Colliers.

I am in somewhat of a dilemma. Shall I ask the lady to speak first, or save the more beautiful for the last?

I would suggest we now hear from Doctor Ruth Bobrov, who has done some excellent work. She is a little bit ahead of us, and I will ask her to explain her work.

DOCTOR RUTH BOBROV,
appearing before the Committee, but not being sworn,
deposes and says:

THE WITNESS: I think I should have to have the blackboard. I did not know that I was going to speak today, so I did not bring any pictures with me. I could have brought some pictures to project, but I did fortify myself with some of the papers I have given, and if my remarks get really bad, I will start reading.

What I shall attempt to do is to break down the plant, as well as I can, and explain what has happened.

I assume in most of the places in which I speak, that most of the people do not know anything about it. Most of them are lawyers, and law-enforcement officers, and so on, so I do want to simplify things as much as possible, and if I do not, just stop me and ask questions. I am looking at it from my point of view, and sometimes I forget.

About 1945, we started to get a very peculiar type of crop damage in Los Angeles County. Every crop was affected; some more than others. It did not seem to look like anything which had been described in literature before; it did not look like sulphur dioxide, nor hydrogen sulphide, but was described as being damage in response to the flow from industrial stacks, but it did not appear the same on every plant.

Los Angeles County was a very important agricultural area. Agriculture today has dropped off, as growers have been pushed out of the area. Some crops are affected more than others, and every crop is affected in a little different way. For instance, with spinach. It began to get silvery on the under surface of the spinach leaf. We have

tried to put it into cellophane sacks, and send it to market, but the bacteria would get into these silvery areas, and would disrupt the leaf, and people would not buy it.

Then there was a problem in regard to the romaine lettuce, and some of the more delicate leafy vegetables. These were damaged and resulted in another crop loss, so it would be impossible to pick it. Months and months of hard work was gone completely.

Tomatoes were affected only slightly. We did find the early leaves of tomatoes were affected, and we found that this crop was being affected by the appearance of a horizontal streak.

We found that chrysanthemums, hibiscus, and many other flowers were being affected, and some of the orchid growers were complaining.

When I came to work on this problem -- which was in 1951 -- I began to wonder what this peculiar damage looked like, and then I saw many different plants, and I asked myself, "What was occurring? Was there any way of finding out what it was?".

When you speak of "smog", you are speaking of a complex matter, which may have fifty different constituents, some aerosols, and some in gaseous form. What was in the smog which was causing this peculiar

damage?

BY MR. BRANDON, Q.C.:

Q. May I interrupt just a moment?

A. Please do.

Q. Why did you attribute your findings to smog?

A. That is a good question. That is what I wondered, too. We would see it around the country following the low inversion, and we felt the eye irritation, and we thought we were seeing the crops beginning to be damaged in the fields. That is why we started to work on it.

We found there were certain responses. I have been in Dominicus, and watched the crops respond to the smog. You have a low inversion, and when the sun comes out, and it starts to get hotter and hotter, we feel then the unsaturated hydrocarbons in combination with ozone which is in the air, and as the sunlight becomes more intense, these combinations become more and more oxidized, and are damaging the plants.

We do not know yet specifically what it is. I do not believe anything. I say, "I do not know". I would not say it was the unsaturated hydrocarbons in combination with ozones. Exactly what it is, I cannot say as yet. Some day, I hope to be able to

answer.

Q. When did you notice smog in this area?
When did you first notice the effect on the agricultural production?

A. The first effect -- I was in the Navy, and when I got out in 1945, and came back here, I did not notice very much, but apparently the agricultural people were at that time beginning to complain. This was around 1944 or 1945. They were beginning then to be pushed out.

If you ask me why it happened at that time, I do not know. It was about that time that the "cat"-cracker came in, and the gasoline constituents changed. There was a change in the breakdown of the raw gasoline, and as they were pumping it to the plant, a new, refined material was becoming chemically active. That is the way I feel. Do not quote me on that.

When I came to work in 1951 and saw these different kinds of damage occurring in the fields, I began to wonder what it was which was happening.

I have been trained as a micologist, which means that for fifteen years I was trained to look through microscopes, and I was very curious to know what was happening to the leafy organisms.

I started a collection of leaves, and stems and roots, and I found no damage to the plant at all in any place but the leaves. You have to understand how a leaf is composed to understand what happened here. There are tiny, minute microscopic stomata in a leaf. If this (indicating) is your leaf, and you take a cross-section through the leaf this way (indicating), and then you go under its surface, that is, under the epidermis. This (indicating) is the lower epidermis, and this is the "upper epidermis", and both the upper and lower epidermis have these small pores, called "stomata".

I noticed something peculiar in the case of spinach. In that case, most of the damage was occurring to the lower surface, and not to the upper surface, and I wondered why. So, cutting through a spinach leaf, you find that you have spongy cells shaped much like this (indicating), with pores entering thus (indicating), and an air space beneath, and the sensitive cells exposed to atmospheric gases as they enter.

Above, the cells were arranged very compactly. They are called "palisade cells". There are small spaces between the cells, but, by and large, you can see when you section your leaf, that there is much

less damage on the upper surface than on the lower surface, since more cell membrane on the under surface is exposed to the phytotoxic agents in the air. We tried it with two, one artificial agent and the other air-borne in the smog, which entered through the stoma, and it depends on how spongy the leaf was as to how much damage occurred in the leaf, and we found that the succulent plants were the ones which were most hit, whereas, things like cabbages, which are thick and leathery, can withstand the damage better, so the real spongy ones are wiped out, and the leathery ones can produce a little bit.

Now, we went on a little farther than that. We found, in the case of both vulnerable and resistant plants, where you have a long linear leaf, they might not die in response to smog, but lines always showed up as tan streaks on the leaf, and we wondered why.

So we have to study normal anatomy of the plants, so we would have something to compare with the pathological anatomy, but strangely enough, nobody has studied it, so far as I know, so we have the double problem of the normal anatomy, and the pathological anatomy.

We studied these streaks and found these small, microscopic pores in a linear arrangement, so in this leaf (indicating) the stoma was arranged in line, and on the lower surface, they were arranged

just under the stomata of the upper leaf and the resulting damage came in from the upper leaf stomata and from the lower stomata, and they met in the middle, and we got this streaky leaf.

I do not want to talk too much about this, because I am not yet certain that this damage is exclusively due to hydrocarbons, and not to anything else.

In a growing plant, we find in most instances that this is the apical point. This (indicating) would be the eldest leaf; this (indicating) would be the younger, and this (indicating) would be the youngest leaf, and there would seem to be leaves in which we never found damage beyond a certain point. We never found damage in the eldest leaf or the youngest, but found it in the middle-aged leaves. In trying to work /this thing through, I believe it has to do with the differentiation of the cells at the new growing point of the leaf. These are extremely compact, so if you do a cross-section, you will find that the cells are arranged so as not to be exposed to damage. The stomata was just beginning to form, therefore, you have no port of entry.

Coming into the middle-aged leaf group; there are certain portions of the leaf which, at a

given time, are just right for damage, so that this number 2 (indicating) would be a group of cells, not just a single cell.

Let us say that these (indicating) are susceptible, mature leaves. The damage in the youngest one occurs at the top, the damage in the next youngest one occurs in the middle, and the damage in the older one at the base.

We tried to figure this out, and we hope we are right, that the differentiation as it develops is from the top toward the base, in other words, the development of the stomata develops first at the top and these are embryonic, just as baby leaves at the top, therefore, no damage.

As this leaf matures, differentiation now occurs here (indicating), but it is still in this form (indicating). Why is there no damage at this point? Because, as the cells grow older, they lay down a wax around themselves, and it is our opinion that this is protected by the cells, therefore, it is not protected all through. These are new, and just beginning to function. This (indicating) is still embryonic.

When you come to this region (indicating), you have it completely suberized.

This has almost always been noted in the reports, and ozonated hydrocarbon does not need any reaction with the sulphur dioxide to do this damage. Whether there are any other things in the world which give you the same pattern, I do not know, but in the opinion of those who have studied it, this is the only thing which will give you this pattern. Doctor Eames, and Doctor Connell, found the same thing when they sprayed apple trees, which indicates to me that he is probably right when he says that this is just taken up by new stomal cells.

This (indicating) is a picture showing a cross-section through an oat. I did this photomicrograph, and you can see how smog will go in and get back of the cell itself, and it is always the first cells in the leaf which show damage.

The only thing about ozonated hydrocarbon damage is that the damage is limited to a small area, surrounding the substomatal chamber, and never moves very far, indicating it is either a highly reactive molecule or that it is very heavy, in which case it settles down.

Unlike sulphur dioxide damage, or unlike ozone damage, where these very, very reactive molecules would kill a whole leaf -- boom -- it goes right down and unless it is a heavy concentration of smog, or of

very long duration, it will not kill the plant, but only damage it. This is the source of our great difficulty in growing.

At a recent convention I was being searched for by one of the doctors attending, and he said, "Gee, I have been looking all over for you. Do you think you could bottle some of this smog? We have grass all over our golf course, which is being damaged, and we are trying to get rid of it. In this area, we would be able to grow poa annua, but we cannot separate single groups", so there they could not get rid of it-- in Rhode Island.

This (indicating) is a cross-section of a leaf, showing damage just beginning, about two or three hours after smog has hit it. You can see the continuation of the cell content, and the cells are still intact.

In this picture (indicating) which was taken about forty-eight hours following the smog attack, you can see the dehydration of the cell and the complete collapse of the cell, and after a while, what happens is you get a complete mumification of the cellular structure. You would get a series of cell collapses, and mumification of the cells.

Just one other thing, and then I will be

through. We endeavoured to study something which was peculiar to just a couple of plants in this area, namely, the common, ordinary table beet, and the dock weed.

We noticed corking occurring on the lower side, and we wondered what corking was doing on such a leaf. Normally, leaves do not cork except when they have been traumatized by insects. We wondered what was happening.

We made some careful studies of this plant -- the beet -- and we found that the initial response of the plant was identical to any other response; in other words, that you would get an engorgement of the epidermis cells. I forgot to tell you about that.

The first response of the plant to smog, following thirty minutes of heavy smog, is the engorgement of the covering cells of the plant. To my mind, this has been completely unsuspected -- but the first response is like the engorgement of the mucus membrane of the nose, and a rhinitis. I postulate there a little, and throw it out for conjecture. If it is the same mechanism, the response is such as humans are getting in the throat and eyes.

Two hours after the smog attacks, there to dehydration of the exposed beet leaf cells. In twelve hours there is plasmolysis of the cells. In twenty-four hours, collapse of the cells occurs and necrosis

is complete in forty-eight hours. By seventy-two hours, mummification of the affected area of the leaf has taken place.

That was the original response of the beet, and following that, we found the collapse of the suspended cells surrounding the substomatal chamber, and about ten days following this collapse, we began to see that the cells which were not damaged, but which were adjacent to the damaged cells, began to cut the cells in. In other words, the cells which normally throughout the life of the leaf and which remained static, were beginning to have a cell division, or a cell cut-in.

These dead cells were pushed out of existence, and then new wall cells became suberized by a wax layer, and that was the foundation of corking.

This (indicating) gives an idea of the cork re-forming in the beets, and is magnified about one thousand times, so you can see this is not a normal cell. These are cells cut into normal cells.

BY DOCTOR EVIS (Secretary):

Q. What do you mean by "corking"? Does it look like a cork?

A. In volume, the corked cell is one which has a very heavily-suberized wall. It is well protected and is generally formed from a divided cell, which forms a protective barrier. In botany, we call it "cork". We get good response to injury or trauma of some kind.

For instance, if a farmer would cut into a potato tuber, he might get a corking form.

Q. Corking would be analogous to kerstinization or scarring in human pathology, then?

A. Yes. We think that smog can directly damage these plant cells, causing much destruction to the crops-- the heavy crops especially -- and number 2 would have the indirect result of possibly causing some cells to divide abnormally.

If there are any questions, I would be glad to try and answer them. Or have I confused you sufficiently? These pictures will show you the form of the cork.

BY MR. MURDOCH:

Q. Are the farm producers very much concerned about this smog?

A. Oh, yes. I was out in a field on Monday, and one chrysanthemum grower left eleven acres, after he had worked them, saying it does not pay. He is now discussing selling it to a real estate man for \$75,000, and I think he had better take it and go away.

Q. Is there any possibility that something else is robbing the soil of its fertility?

A. No, definitely not. As a matter of fact, if you give plants an even better mineral environment than they have, that may fertilize like the dickens, but the more you fertilize, the more damage you get, and you have plants with a higher metabolic rate, and

therefore, more susceptible.

We tell the farmers to hold back on their fertilizing and their water, and to keep their plants as dormant as they can.

Q. If it only affects the succulent type of leaf, how about alternative crops which may not be affected?

A. That is what they are doing. That is what they are doing up to date. You can bring beets through to market, because in this area we do not bother too much with the tops of the beets. I do not know whether you people do, but we do not bother with the tops very much. They come through pretty good, but the yield is lower, and they are trying alternative crops; they are putting in things like cabbages today,

Some kinds of lettuce we find come through, and New Zealand spinach, but you have to educate the housewives to the new vegetables. They do not like to use New Zealand spinach, when they are used to the domestic spinach.

Just one certain thing. We do not know all the facts of the effect of smog on plants. I was doing an inspection in Uplands on Saturday, and a citrus grower was complaining rather bitterly that the size of his fruit was cut down.

BY MR. MURDOCH:

Q. These studies are actually in their early stages?

A. Yes, there is nothing in past experience to go on.

BY MR. ELLIOTT:

Q. How about pine trees and spruce?

A. I can only conjecture. I found it in a lepo pine growing in Riverside, and the man was losing trees, and he went to the Branch with them, and Doctor Miller gave it to me, and it showed typical smog damage. I do not want to stake my meagre bank account on it, but I believe that is what it is.

I noticed in Uplands, that the grape crop is being affected. Any time you allow a port of entry for this stuff into the inside of the plant, you may expect trouble.

BY MR. MURDOCH:

Q. In that regard, any area where they normally do not have smog, almost invariably they have a new type of insect pest?

A. I think that the eventual hope is to get the stuff out of the air. I feel this problem has not indicated that this atmospheric interchange is immutable. We are trying to get it out of the air, and once we get it out, we will be in a good way.

BY MR. BRANDON, Q.C.:

Q. In answer to the question I asked a while ago, I assume there was no noticeable effect on plant growth

until 1945, that is, that there was no noticeable smog until the post-war period, when there were varying new grades of gasoline.

A. It is my understanding, from having talked to farmers, that they were not complaining until the latter part of 1944 and 1945.

I know one man who was growing mustard next to one of the gasoline stations, and he said he did not notice it until the end of 1944.

Q. Has there been any study made as to whether the lead in the gasoline has had any effect?

A. I think Doctor Mader will know that.

DOCTOR MADER: There were a number of studies made on the effect of lead with regard to two policemen, who are, day in and day out, exposed in the downtown Los Angeles area. It was thought surely a high rate of concentration of the lead would be found, either in blood tests or urinalyses, but it was found the lead stayed fairly low, in spite of the exposure to downtown traffic.

The reason why policemen were frequently changed from the downtown area was not due to the lead concentration, but they could not stand the committee's argumentation.

MR. MALLOR: Thank you very much, Doctor Bobrov.

MR. THOMAS (Oshawa): I do not know of any speaker who has received so much attention for such a length of time, as Doctor Bobrov.

MR. MALLOR: Now you know why we think of her as "the sweetheart of the District". When you speak of "beautiful ladies" you nearly always hear someone say, "She is beautiful, but dumb". In this particular case, she is not only beautiful, but very intelligent, and we are very proud of Doctor Bobrov.

At this time, I will ask Doctor Mader to come forward and speak to you, and tell you something about his past work in the District.

He came from Vienna, and I am sure he will have some very interesting things for you to hear. He has done a great deal of work in the field of research, and has done a great deal of publicity, so I am very happy to introduce to you at this time, Doctor Paul Mader, but before he speaks to you, perhaps we might adjourn for, say, five minutes.

---Whereupon a short recess was had.

---Upon resuming.

D O C T O R P A U L M A D E R,

called before the Committee, but not being sworn, deposes and says:

THE WITNESS: Gentlemen, I will try to present to you the highlights of a paper I had a chance to present about three weeks ago to the American Chemical Society convention in Minneapolis. The paper I gave there was entitled, "The Effect of Present Day Fumes on Air Pollution".

Most of the recent reports which come out of the air pollution problem in Los Angeles, points in the direction that oxidation products with hydrocarbons are responsible for all the conditions we are noticing here, like crop damage, lower visibility, and all the other phenomena which were mentioned. I think the only phenomena which was not mentioned today was the fact that we have a highly-oxidizing atmosphere, as expressed in the smog of the Los Angeles area. So most of the smog can be attributed to the fact that nearly 1,600 tons of hydrocarbon are being released every day into the atmosphere, and when that is exposed to sun light, and the air, the oxygen has a catalytic effect, and ozone and nitrogen materials, like the aldehydes are formed, and visibility is reduced.

The concentration of 1,600 tons of hydrocarbon is usually broken down, but about 1,200 tons of hydrocarbon, which is being attributed to automobile exhaust vapours--where unburned vapours are discharged into the

atmosphere.

Not all the hydrocarbons show the same tendencies, and, therefore, the formation of oxidation processes.

The first material, for instance, is the saturated hydrocarbon, where the carbon was connected by one link between each other. These hydrocarbons are very inert, and no matter what the quantity is, which is being discharged into the atmosphere, the amount of oxides formed will be fairly low.

Another group is the unsaturated carbons which contain double bonds in their molecules. They are fairly active, and when this hydrocarbon produces on exposure through ultraviolet radiation and by oxygen, it is understandable that most of the blame for the oxidation processes has been attributed to hydrocarbons, and especially the unsaturated hydrocarbons.

Since these hydrocarbons are the original materials from which the more noxious compounds are formed, we undertook a study to determine the oxidation potentials of these hydrocarbons.

By "oxidation potentials", we mean the ability of each individual hydrocarbon to form oxidation products, and the quantity which is being formed, and the ratings with which oxidation products are being

formed in the atmosphere.

The way we went about it was to take the individual hydrocarbons we wanted to test, and introduce them into a 50 litre flask, and add some oxygen or nitrogen in the right proportions, as would be found in the atmosphere, and expose that mixture which previously did not contain any aldehydes, and expose it to ultraviolet light, and see if, after two hours, what quantity of aldehydes formed in that time.

We noticed that after certain lengths of exposure, the amount of aldehydes formed was about 5.2 parts per million.

We did not have any heptane as such, and it would be too long a table if I were to try and mention all the straight hydrocarbons which have been used for this particular purpose.

Heptane is only one, and no matter what the chain length was, we always found a concentration of between 5 and 7 parts per million of aldehyde formed in this particular manner.

Then we went to the straight shaped hydrocarbons, the unsaturated hydrocarbons, and we noticed with respect to the olefins that there was a considerable difference in the amount of aldehydes they were capable of forming.

When you take the alpha olefins -- and by "alpha" I mean hydrocarbons which have a double bond in the terminal position, and treat in exactly the same manner as the other hydrocarbons -- we find that about 17 parts per million of aldehydes were formed, as compared with only 5 parts per million from straight shaped hydrocarbons. But this is not too much, either. We get into much higher figures as we move from the terminal position into the internal position, so the moment we are dealing with the internal one, we find sudden increases in the aldehyde concentration which these materials are capable of forming.

Assuming now we have equal quantities of the internal and double bond material, with the double bond in two positions, we can see that the amount of aldehydes which are being formed is about 150 parts per million, as compared to 17 parts per million in the terminal position.

We have another type of hydrocarbon here which has double bond, terminal position, which is the same as the terminal position here (indicating), after the hydrogen is replaced by oxonation.

You will notice that the extraction of these aerosols into the molecules change the amount of aldehydes from the expected number of 17 parts per million

to 97, which we also found in the same category, as if the double bond had been switched from the terminal position into the internal position.

Having analyzed now the hydrocarbons for the formation of aldehydes, we noticed that these two types of hydrocarbon, the straight shape, and the double bond, are not only producing a fairly small amount of aldehydes, but the amount of aerosols which is being produced inside the flask was very minute, but the amount of aerosols being produced by the internal double bonded and the terminal hydrocarbon was quite large.

We took a few of these hydrocarbons and submitted them to Doctor Smith at the California Institute of Technology. He has an instrument set up to determine the formation of ozone when under exposure to sun light, and you will notice that the formation of ozone in the internal hydrocarbon is very minute, but the quantity of ozone formed by the other three types of hydrocarbons is very great.

In addition to the aldehyde formation, several other oxidation products were determined.

MR. MELLOR: Doctor Mader, may I interrupt you for just a moment? I am sorry.

DOCTOR MADER: That is perfectly alright.

MR. MELLOR: Gentlemen, Mr. Griswold has just come in.

MR. GRISWOLD: It is a pleasure to have you gentlemen here, I assure you. Will you proceed, Doctor Mader?

DOCTOR MADER: Well, gentlemen, it has been pointed out before that the aldehydes which are produced by these types of material, straight and alpha, are not, in the same concentration, being released into the atmosphere, as when you have the other type of double bonded.

BY MR. BRANDON, Q.C.:

Q. As a layman, and not knowing too much about this particular phase of what you are telling us, as I understand is, you have five different chemical combinations of hydrocarbons.

What I would be interested in is in knowing where any of these five combinations of hydrocarbons which you have mentioned to us, fit into the smog situation? Are they related entirely to the petroleum set-up, or where do they come into this picture?

A. That is the next point to which I was coming. I will try to answer your particular question.

It was not before 1944 --

Q. May I ask you a further question, Doctor

Mader? What are "aldehydes"? That does not mean anything to me.

A. "Aldehydes" are oxidation products which these hydrocarbons form when submitted to sun light. It is the property which reduces the visibility. If a lot of aldehydes get together, they form aerosols, and you have a large number of molecules, and aldehydes, and that causes the irritation to one's eyes, and of one's skin.

DOCTOR EVIS (Secretary): May I assist you, Mr. Brandon? Do you know what formaldehyde is?

MR. BRANDON, Q.C.: Yes.

DOCTOR EVIS (Secretary): Did you ever smell it?

MR. BRANDON, Q.C.: Yes.

DOCTOR EVIS (Secretary): That is an aldehyde.

MR. BRANDON, Q.C.: I have not seen anything in Los Angeles that is anything like formaldehyde.

DOCTOR EVIS (Secretary): It has been very clear today. If you had come in on Saturday, as we did, your eyes would have been irritated.

MR. ELLIOTT: It is a type of formaldehyde?

DOCTOR EVIS (Secretary): No, it is one example of that aldehyde, just as when you say "sugar",

you have brown sugar, white sugar, powdered sugar, and so forth.

BY MR. BRANDON, Q.C.:

Q. Pardon me for interrupting you, Doctor Mader.

A. That is perfectly alright.

All I want to say is that these materials are extremely undesirable if they are released into the atmosphere, because they are capable of forming products in large concentration, and these products have all these undesirable features, such as the Los Angeles smog has.

Q. Have you had an analysis made of smog in Los Angeles, which would be a check on the production of these five classifications of hydrocarbons?

A. Yes.

Q. Then may I ask you one further question? In relation to the number of parts per million; where do we come to the part which is irritating to one's eyes in these classifications?

A. Only 1 part per million in the atmosphere.

Q. Are all these injurious?

A. No, the aldehydes are.

Q. What I am getting at is that you have five classifications?

A. Yes.

Q. Are all of these five classifications injurious to one's eyes?

A. No. Aldehyde, I would say, was injurious as far as irritation is concerned, and they are capable of forming aerosols, which reduces the visibility, and the reduction of visibility is one thing about which the people are complaining.

Q. What I cannot understand at the moment is this; in these five classifications you have shown us, five parts per million to 97 parts per million; somewhere between the two, as I understand it, there is something in that field which is irritating, or begins to become irritating to one's person.

My question is where did you, in arriving at such ratio, connect it with the Los Angeles smog?

A. These experiments were made with individual aldehydes, and taking the aldehydes individually, people are already sensitive to a concentration of one-half part per million of aldehyde if it was in the atmosphere. But this was not done in the atmosphere; it was done in a flask, in which we put gasoline constituents, and to determine the total amount of this in the flask, it was rotated --

Q. I understand these are laboratory tests?

A. That is right.

Q. Do you have the equivalent in the Los Angeles smog -- in the environs of the city -- that is, which are equivalent, in fact, to these laboratory combinations you have tested?

A. We have the equivalent, from the fact that 1,200 tons of hydrocarbon is being discharged into the atmosphere, and in the atmosphere, this occurs. It is the same kind of process that our laboratory experiments were subjected to. In other words, we subjected gasoline vapours to the same type of experimentation you would find with automobile exhaust vapours.

We also experimented with the losses from the refineries. We were limiting ourselves to pure compounds. We took gasoline vapours from all kinds of gasoline, and from different companies, and worked with those, and subjected those to the same treatment -- to sun light, and so on -- and measured the amount of noxious materials, such as are being formed.

At the moment, all this is supposed to show is that if hydrocarbon of this particular structure is being discharged into the atmosphere, it is able to form a large amount of injurious materials, whereas these types of hydrocarbon would also form some amount of aldehydes or peroxides, which I did not bother to figure now, but the quantity would be comparable to 150

parts per million, and almost negligible.

Q. Is there anything in the matter of gasoline --

A. I will come to gasoline right now.

We noticed in 1944 -- which was about the year when the people of the Los Angeles area began to be aware of the smog condition, although some of the old-time residents of this area seem to remember that there were days before 1944 when smog was around, but as far as the properties of smog itself and the intensity of it, the days before 1944 cannot be compared with what we experienced after 1944, and we were wondering whether the changeover of cracking had anything to do with the smog condition as we experienced it after 1944.

BY THE CHAIRMAN:

Q. What is the difference between the "thermal" and the "catalytic" cracking?

A. There are two types of cracking gasoline. Mostly it is more effective when the carbon length is between six and ten, but the raw gasoline very often contains about thirty to forty carbons in one long chain, and these materials in one long chain, are not very efficient fuels. So, in order to increase the efficiency of these fuels, they have to be broken down from a one-chain molecule into smaller chain

molecules, and the way it is accomplished is by a cracking procedure; in other words, they were just cracked into portions.

The way it is done by thermal cracking gasoline was to use chambers which --

Q. I did not mean how it was done, Doctor Mader, if you do not mind. I meant what was the difference between the two crackings and why is that being done? Just briefly, put that on the line; what was the difference between the two, and why did you do it?

A. The reason why we changed from one particular type of cracking to the other was on account of the deficiency, and the highest you would get by using another method is by the catalytic-cracking procedure.

Secondly, it was found that not only was the yield increased, but the octane rate increased.

Q. Which is the better?

A. It is a better grade gasoline from every point of view. After an analysis of catalytic cracking of gasoline, in comparison with the thermal cracked gasoline, it showed we had increased these hydrocarbons -- which are more undesirable by being admitted to the atmosphere -- by about 95 percent. In other words, in order to increase the octane rate of high grade fuels,

such as we are using at the present time, we have to introduce material which looks, as far as their structure is concerned, like this (indicating), but at the same time your materials which run most easily in the atmosphere, when they are discharged into it, cannot be burned more easily, but give you an oxidation production turn-over rapidly in the atmosphere, but do give you more power.

So, the analyses of the thermal-cracked and the catalytic-cracked fuels revealed there was a substantial increase in the undesirable types of carbons, which we did not want.

Q. That is very clear. I can follow that. Do they catalytically crack fuel in any of the other states? How do we do it in Ontario, for example? Do you know?

A. I cannot say about Ontario, but in the United States they are using catalytic-cracked and thermal-cracked together, to give a premium fuel, made by the mixture of thermal and catalytic-cracked gasoline, or straight gasoline.

There are a few independents here in Los Angeles who have not converted from thermal to catalytic, because not every refinery has \$50 million available, which is the cost of the catalytic cracking equipment.

BY MR. BRANDON, Q.C.:

Q. Dr. Mader, if I may ask another question: we have in Ontario, as you have in the United States, a manufacturer of gasoline who has recently advertised on TV that when burning the gasoline, you put a plate over their product, and there is no carbon deposit, and you take another gasoline and put a plate over the burning of their product, and you get carbon dioxide.

With the clean burning gasoline, is there 100 percent. consumption or is there still carbon deposits and odours given off? Would that have a detrimental effect, or what is the situation?

The United States product is the Gulf gasoline and the Ontario product is the British-American.

A. I realize that. One of the reasons why the present-day fuels do give a deposit on burning -- at least, the catalytic constituents give a deposit on burning -- is that we formerly used what they call the "acid treatment", and the acid treatment of the gasoline was prior to its being sold.

The reason for the acid treatment was to remove materials which form gums. Gums in gasoline have been known for a long time, and if you do not use your car for two or three months, you will find there is plenty of gum formed.

They have found now, after they went over to

the catalytic-cracking, that they have removed the gum formations, and they removed at the same time different types of material which contributed to the octane rating, which means they have better fuel, therefore, they decided -- certain companies decided -- that they should acidate, so they could estimate how long it would usually take for a certain quantity of gum in the gasoline they manufacture, to be used up and by that length of time they estimated the amount of ingredients to put in to prevent the gum formation.

That is the reason very often why a good part of the gasoline still contains gum formers, and that was the function of the type of gasoline where the gum fomers have been removed.

Q. May I ask this question? In your opinion, is the gasoline which is clean-burning as injurious in the Los Angeles smog area as the one which is carbon-deposit burning?

A. I would put it this way; I would rather see the acid treatment applied, but using the acid treatment would not give you the same high quality of gasoline you are getting at the present time.

In order to obtain the high quality of gasoline they have to put in certain ingredients, which give you again a higher octane rating without any deposit

on burning, but, of course, you would have to pay the price.

Q. To answer my question, is one as injurious as the other?

A. Oh, no.

BY THE CHAIRMAN:

Q. Let me get a question in here now. Are we to assume from your scientific experiments that the catalytic gasoline will produce the best gasoline, the high-powered gasoline, is one which produces the worst type of fumes, and as we improve our gasoline type, we will get more and worse fumes in the air?

A. That is about right.

Q. Say you spent \$50 million here, but in the long run by the improvement in the gasoline, it will continue to contribute to the smog condition?

A. In the conclusion I have in this paper here I say in Point No. 4:

"The quality of the improvement of it presenting powerful fuel is not to be due to a substantial increase in the internal double-bonded olifins.

"However, from the air-pollution point of view, the same compounds will give you a better gasoline which is very undesirable if permitted to

be discharged into the atmosphere."

BY THE CHAIRMAN:

Q. That is so. That answers the question.

A. Are there any further questions, gentlemen?

(No response).

Now, my last point -- and I hope I do not go too far with that; when I say:

"Since the use of the present-day fuel is not limited to the Los Angeles Basin smog conditions, but is also developed in other congested automobile areas, where stagnant air conditions and low wind speeds prevail"

I mean, in other words, if I go to another industrialized area, which has not any refineries close by as we have here, if they are using the same type of premium-grade fuel, they will get a very fast pick-up but they admit a lot of hydrocarbons, which we do not want in the atmosphere.

BY MR. BRANDON, Q.C.:

Q. Do they have a similar situation in Seattle as in Los Angeles?

A. I am not familiar with Seattle, but in San Diego they have a similar situation. There they have tested the atmosphere for hydrocarbons.

MR. MALLOR: I wonder if the question has been answered. They have no situation similar to ours, but I would like to say a little bit about how that is done, by mentioning the thermal and the catalytic processes. I will not go into too much detail in regard to the thermal cracking. It only means the raw material is brought to the cracking point, which is very hot. It is subjected to very high temperatures, especially the inside cells of the thermal cracker, which are red hot, and when these long-chain molecules hit the wall of the thermal cracker, they are just split into smaller molecules, and these smaller ones are the ones which are more efficient in powering your automobile.

As far as the catalytic cracking is concerned; the procedure is to apply a heat load, but you do not have to go to the same high temperatures to effect the cracking. You are using catalysts, or what they call a "liquid cracking procedure", because when cracking catalytically, the solids are so fine that they resemble flowing conditions.

So, in the presence of these catalysts, the material is effected, but you do not have to go to very high temperatures, and the cracking is more efficient.

The catalyst is working, and it regenerates itself every time after it has been used, until it is called a "spent catalyst", and cannot be used any more.

BY THE CHAIRMAN:

Q. It breaks the molecules smaller than the thermal?

A. Yes, and by varying the temperatures, the refiner has it almost in his choice to produce any type of hydrocarbon he wants to make, by using these cracking conditions, and he will get a different product, and a different yield.

BY MR. THOMAS (Oshawa):

Q. The breaking up of the molecules is not only due to temperature, but also to pressure? Is the catalytic cracking the result of great pressure?

A. The pressure is usually not built up too high; in other words, you cannot stand this high pressure. They are built up by the quantity of the highly-volatile material you have there, regardless of whether you are using one procedure or the other, but the unit itself could not stand too high temperatures, and at the same time increasing the pressure.

BY MR. BELYEA:

Q. What is a polycyclic?

A. These are hydrocarbons and they are straight-chain hydrocarbons. You have to have the open chain to make high powered gasoline for automobile use. The unsaturated chains are the irritating and dangerous ones.

Some are formed in the cracker and some are formed in the cars. The reason they are formed in the cars is that some people have automobiles in poor condition in which high temperatures develop and they act like a thermal cracker.

Q. Polycyclic hydrocarbons are of the same --

A. They have about five rings, and the materials for this particular structure are benzperylene and benzpyrene, which is the more likely --

Q. You are more likely to get these from catalytically-cracked gas?

A. You do not get them from catalytically-cracked gas, but you might get them from the automobile exhaust, especially from the tail exhaust.

---Doctor Mader retired.

M R. S. S M I T H G R I S W O L D,

appearing before the Committee, but not being sworn,
deposes and say:

THE WITNESS: Do you think this would be a good time for any of the members to ask questions on any phase of this air-pollution problem, which probably would be instructive to you, not to speak of the other members of the assembly.

BY THE CHAIRMAN:

Q. Doctor Mader has done very well on the questions, up to now.

A. There might be other phases which might be interesting..

I regret I was not able to attend the meeting. I wanted to say a word, because our Los Angeles Chamber of Commerce has spent 65 years in bringing industry in here, and have been eminently successful, but despite the fact that industry has the most efficient controls, there is still more dissipated into the air than the air can take, in combination with all the other sources of air pollution.

You gentlemen have heard that we established an 8-point programme, two of which are most important. One is that we do not have to educate the public transportation system here. The total population

per square mile is not great enough to support economically a system such as those found in New York, Chicago and Philadelphia. In spite of that, they are coming out now suggesting something like a monorail. However, we have an earthquake country here, and the rocking could be dangerous. We cannot put subways in, and we will not have the elevated, such as they have in Chicago, so we have to have some type of rapid transportation which the people will accept.

People are living in forty-six cities in this County, and there are people living in outlying areas, such as Paloma, and even in Long Beach, who will not come into the city once a year. They like their own communities..

You will find that most of the people here are relatively newcomers. There were only 225,000 people here in 1922, so actually within my time there has been more than four and one half million people come in here. I came in myself from Idaho and Utah and most of them are like myself; they call themselves "Californians", but they are not. We have had the greatest migration in history and that has spread in all directions. Lots of people who are not really Californians, take pride in California. They

have various state clubs here. If you go to an Iowa club, for instance, you will find two or three thousand there from Iowa, and they are not interested in the metropolitan centre of Los Angeles at all; they are interested in their own little communities.

That is why we never have any big conventions or big league baseball or any other of the things which are inherent in the usual metropolitan set-up. Their pride is in what their fathers and grandfathers have done, and they do not want it too complicated.

In spite of that very unique situation, studies have shown that within the next ten years, this will be the second largest city in the United States.

We have had the same air for 1,000 years now, and we probably will still have it a 1,000 years from now, and we are faced with the tough problem of taking care of it.

We have two problems here, one is fresh water and the other is fresh air, and that is why we have such rugged air-pollution control activities.

We are bringing water in from the Owen Lake, and I believe they are now bringing it in from Colorado. The water problem in Southern California is a great one, and if you turned about ten valves, this would be a desert. Actually, I think the

water level has dropped about 43 feet in ten years, and I think we get less than 30 percent. of our water supply by pumps from underground.

BY THE CHAIRMAN:

Q. Are you processing the salt water from the ocean?

A. Not at all.

Q. Does the water come in by gravity?

A. Some of it is pumped.

Q. Are they experimenting with that? I understood they were.

A. There has been a great deal of experimentation, in fact, there has been some before I came here.

I was, for six years, the Director of the Budget for Los Angeles County, and at one time the Board of Supervisors offered a \$1-million prize to anybody who could process the salt from the ocean water so it could be used commercially, and which would be economical to use, in comparison with the expensive methods we have in bringing it in now.

This area basically is a desert. It only rains here a little in January and in February, and some in March, and the average precipitation is only about nine inches.

BY MR. MURDOCH:

Q. Our Ontario Legislature also appointed a

Committee on water levels, because we are having the same problem. Our underground water is disappearing and nearly all of the farm land is tiled, with the result that we are running into dry periods in the summer, and many of our fast-growing towns find they cannot get underground water any longer.

A. There is a suit filed in court in the city of Los Angeles, right now. You all know that we have Hollywood here. Hollywood was at one time a separate city. Mayor Dunlop, who ceased being Mayor about 1932, said they needed water and they came to Los Angeles, and Los Angeles said, "Alright, if you want to use our water, you must use our tax rates". Hollywood is the name of an area, like Waikiki, a section of Honolulu. Los Angeles has annexed quite a few cities the same way, and now they have filed this suit to prevent Burbank and San Fernando from pumping more water. They say they should quit pumping it out of the wells, because when it is pumped out of the wells, the supply for the city of Los Angeles will get pretty low.

For years, Southern California has been in litigation with Arizona and several of the adjoining states for taking their watershed, which they say is a breach of their riparian rights, and there have been

shotgun battles, amongst the boys of the old west. They have blown up the pipe lines, the water pipe lines and the petroleum pipe lines, and many of these cases now have gone to the Supreme Court of the United States.

Now, you can see that in addition to having that problem staring us in the face, we also have the problem of this air-pollution, and yet in this area is growing the greatest mass immigration in history since the end of the war.

Just the other day, I turned down \$76 million worth of construction here in the form of five power plants. Boulder Dam cannot generate enough --

Q. Steam generation?

A. Yes, to burn gas in the summer and fuel oil in the winter, and the applications were turned down, because of the fact that the Edison Company made the application for the plants, using SO^2 , and we have no control over SO^2 .

Now that they have burners for gas, and also for fuel oil, they can switch over, and there may be a change.

All our houses are heated by natural gas in the winter time, which is pumped from Texas, and there was one project to bring it down from Canada through

British Columbia and Alberta by pipe line.

BY MR. BRANDON, Q.C.:

Q. You mentioned one of your problems was transportation; is the relation of that problem to air pollution caused by a great number of vehicles transporting people in and out of Los Angeles?

A. That is right. Here there are 2.1 cars per family.

Q. You mentioned a number of people living in the outlying districts who never visit Los Angeles during the course of a year. Are they employed in the localities in which they live, or do they work in Los Angeles and live in the outlying districts?

A. A great many of them live outside. Mr. Atkisson lives 26 miles out, in Pomona, for instance, and because so many live outside, we have to construct these great freeways, and the state taxes on gasoline can only be used for highways.

Q. What is the tax?

A. I think it is four cents. We have the Federal and state taxes.

BY MR. MURDOCH:

Q. You mentioned you have 2.1 cars per family?

A. Yes, more than two cars per family. Every adult usually has a car.

Q. Well, you might say you have two cars in each garage here, but in Ontario, with the cars getting larger and larger, we soon will be having people who will have to build two garages for one car.

A. Yes, we have the same problem here.

BY MR. ELLIOTT:

Q. You said the gas tax is all spent on highways?

A. Yes.

Q. Is it sufficient to build these thruways?

A. Oh, yes. There is a complicated system of "kick-backs" from the state and county. We have in the county a Good Roads Commissioner, who will spend about \$13 million or \$14 million this year on secondary highways.

These freeways are a combination of primary highways and state highways, and the Federal highways are also being policed within the forty-six municipal limits, by a recent Bill. In a great many instances, this county has built very fine highways, but the state has taken them into their secondary highways.

BY MR. ELLIOTT:

Q. We have a much bigger area to cover, and our own gas tax is almost double that of yours, but we do not have enough to pay for the highways.

DOCTOR EVIS (Secretary): It does not all

go for highways.

BY MR. ELLIOTT:

Q. We spent \$220 million on highways, and the receipts from the gasoline tax were only about \$100 million.

A. I do not remember actually what the revenue derived from the state gasoline tax is.

In our smaller towns, we derive a terrific amount from the sale of 5 million gallons of gasoline every twenty-four hours, but a lot of that, I think, is spent in the so-called "cow counties".

BY MR. BRANDON, Q.C.:

Q. Do you have interurban buses operating regularly?

A. The greatest bus line has been on strike, that is, the Los Angeles Transit line. Our bus lines do not carry 10 percent. of the population who commute.

Q. What about the electric lines?

A. They are --

Q. I noticed there were three cars hooked together, and they seemed to be tied up.

A. They went broke. The costs got up so high, they were not carrying anybody, and they requested authority to abandon their rights of way. They formerly ran to Pomona and Long Beach, and down to Santa Monica,

but they are rapidly going out.

They were very fast locally, but they did not compare with the Illinois Central, and some other of your eastern transportation systems.

---Discussion re sewage disposal, not reported, by direction of the Chairman.

BY MR. BRANDON, Q.C.:

Q. In connection with your legislation on air pollution; is it retroactive, or is it all-inclusive?

A. In some cases, yes, and in some cases, no. Those who were under the Act in 1947, can only be forced to comply when the property is sold, and a new owner comes in.

Q. What about a case where the owner dies, and the property goes to the executor?

A. It is the same thing.

Q. That is considered to be the same owner?

A. Yes.

Q. It is qualified land use?

A. No. If it was built before 1947, then the city has no power, except in this one instance, which we have availed ourselves of. We have passed regulations.

There is a regulation which was passed last July, whereby these apartment houses -- some 1,500 of

them -- were supposed to provide for hauling that stuff, and burning it in the multiple chimney incinerators, which would burn about 25 pounds of pollution per burner. But that required public hearings, advertising, and action by the Air Pollution Board.

Q. May I ask what is proposed at the end of two years, when you are going to restrict the use of the incinerators? What will you require the owners to do?

A. That was the problem. The city of Los Angeles had too big and too complicated a problem on hand. They were not sure in their minds whether they wanted to do it by contract, or establish a municipal collection service in this 441 square miles.

Q. Then you do not own nor operate any municipal incinerators in the area?

A. The only ones were a couple which we built as long as ten years ago, but they have not been approved nor authorized as yet.

Q. Are they burning any combustible material?

A. No.

Q. There is an investment there which is not being used?

A. No, the contractors went broke, and the bonding company took over and the city is negotiating

with the bonding companies, but whether the city will accept them or not, I do not know.

Fortunately, the city included in these contracts that they must comply with our rules and regulations. They could not comply, either from an industrial standpoint or a family standpoint.

Q. Has the municipality ever thought of using them?

A. They were built by the city.

Q. I thought they were built by contract.

A. They were, but had to be approved by the city.

Q. They are new, and have never been used?

A. No.

BY THE CHAIRMAN:

Q. Just sitting there for ten years?

A. Some of them -- the one on Jeffrey Street, and the one on Lacey Street, were not built quite that long ago. There is one on the Terminal Harbour and Alhambra, which was one closed up, because the city said they had to put an electronic precipitator on it.

BY MR. BRANDON, Q.C.:

Q. Has there ever been a study made to determine whether or not it would be more beneficial to operate a municipal incinerator?

A. A study was made in the city of the Alhambra, which had built an approved incinerator, with a capacity of about 120 tons per twenty-four hours. They operated that incinerator for five years, and then they shut it down, because they found they could haul it cheaper than incinerate it.

Q. Is that not at least a factor -- and perhaps the major factor -- in your problem?

A. That is a very important factor. In fact, when these 60 scientists came out, they said they would not burn anything in this area at all.

However, I feel that we have rigid regulations requiring the best type of combustion engineers, and in order to offset some of these "pump-house checking" -- if you want to call them that -- there should be some constructor of incinerators, nationally known and recognized, like Boris Bolge, of the American Incinerator, who have been building incinerators for years, and who could build one which would comply with our rigid rules and regulations. These regulations are more restrictive than any others in the United States.

Q. Are your regulations too strict?

A. I do not think so. I would like to make them more strict. An insurance company which financed

a group of apartment buildings, spent over \$1 million, and they worked very closely to the regulations, but I would like to see our regulations tightened up, rather than liberalized.

MR. MURDOCH: I do not think, Mr. Chairman, we should wear out our welcome here.

THE WITNESS: I want to apologize again for not being here. So that you will get a perspective of this, I think Doctor Evis has some material which may interest you.

I think you have been told about Los Angeles County. Its annual budget is around \$400 million, which is greater than that of more than 40 states. We do not know what the capital investment is, but it is run by these five men, one of whom you met today. They are faced with a rather rough problem. When they meet one situation, they are immediately faced with two or three others, such as the necessity for some additional juvenile institutions, or they are told that the hospitals are overcrowded.

There is one thing I would like to have you understand, and that is that the County also does the tax assessing and collecting for 42 of the 46 cities. The County Health Officer performs the public health functions for the full number. So the County of Los

Angeles has the privilege of paying for the County health services, besides setting up its own. Here you have a unit of the State government performing the home-rule functions for 45 cities. The city of Los Angeles has its own assessor, so if you live in the city, you will have a valuation assessed by the County assessor, and also by the city assessor, who might place a higher valuation on your property.

MR. BRANDON, Q.C.: Mr. Griswold, on behalf of all of us here assembled, I would like to say "thank you" , to you and your associates, for the good information we have received today, and which you have made available to us.

THE WITNESS: Thank you, very much. If your Committee feels it would like to have another meeting after you have finished with the others, perhaps we could arrange an evening meeting, where we could have the top men of the District present. It would not be any lecture arrangement. It would simply be that you gentlemen would ask any questions which came to your minds between now and the time you feel you have to leave, and we will do the best we can to answer them. You will probably see a lot of things between now and the time you leave, and we would be glad to give you all the information we can.

--Whereupon Mr. Griswold retired.

---Whereupon the further proceedings of this Committee adjourned until Thursday, October 6th, 1955, at 8:15 o'clock, in the forenoon.

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APPENDIX "A"

"SOME IMPORTANT ASPECTS OF AIR POLLUTION"

MR. PAUL MAGILL: I am the Technical Director, Air Research Laboratories, Stanford Research Institute, reporting on (1) factors involved in temperature inversion, and (2) the identity and major sources of air pollutants in the Los Angeles area.

On the West Coast we hear quite a bit about temperature inversions in the lower levels of the air. Their existence is one of the principal contributing causes to air pollution on the West Coast. Knowledge of why they occur is important to understanding why nothing has been done to remove them

Visualize, if you will, a large column of swirling air between the Pacific Coast and the Hawaiian Islands. Looking down upon it, this swirl of air rotates clockwise, with the eastern edge of the swirl enveloping the entire Pacific Coast and the western edge somewhere between the coast and Hawaii. This air swirl is tilted at an angle and the air that reaches the Pacific Coast has become heated by compression through the same mechanism that causes a bicycle pump to get hot when you use it.

Also important is a rather steady wind that blows from the north toward the south along the coast. Contrary to what many people suspect, the water does not move with the wind but at an angle to it and away from the coast, i.e., toward the west. As a consequence, the surface water flowing out from the coast is replaced by

frigid water from deep down in the ocean. Because of the peculiar shelving of the land, this is especially noticeable in the San Francisco area and makes ocean bathing there uncomfortable.

This set of large-scale meteorological forces is important to air pollution because it means that air flowing inland at San Francisco and at Los Angeles has passed over thousands of miles of chill ocean water and has become cooled in the process. When the ocean breezes blow into either Los Angeles or San Francisco, we have cool air coming in under the layer of warm air created by the large Pacific air swirl. These two air masses do not mix and any waste that we put into the air when these air masses lie over the land cannot be carried away vertically

In Los Angeles there is the unfortunate circumstance that the winds moving horizontally are not strong, so that the air pollution generated there hangs around. In the San Francisco area, the situation is much better because there are the large air outlets through the mountains into the Santa Clara, San Joaquin, and Sacramento Valleys. On the average, the horizontal winds are stronger in the San Francisco area, and there is much better ventilation. Sometimes even in the Bay area the winds fail us.

The rest of the story is that we are now putting much more into the atmosphere than we have in the past and are accumulating more material in the atmosphere than

we care to tolerate.

IDENTITY AND MAJOR SOURCES OF AIR POLLUTANTS IN
THE LOS ANGELES AREA

In Los Angeles the polluting materials do not come from any single source, but from a multitude of sources. They are not restricted to industrial emissions, nor to acts of the public. They come from both. Just what these materials are may not be important to discuss in detail at this time. We have analyzed the atmosphere and can name at least 50 different impurities. The major types are indicated in Table I.

We know from our own experience that we can introduce as little as one pound of material into the atmosphere and later pick some of it out of the air 20 miles away. So, whenever you see a smoky stack or something giving off dust or fumes, you can be pretty sure that this is contributing to air pollution over a considerable area

The burning of all materials, including fuels and rubbish, are activities that contribute in an important way to air pollution in Los Angeles, as well as in other cities where air pollution has become a problem.

Without going into detail and naming all of the materials that have been found in the atmosphere,

TABLE I

ESTIMATES OF TONS OF POLLUTANTS EMITTED DAILY TO THE LOS ANGELES ATMOSPHERE BY COMBUSTION PROCESSES (1950)

Material burned	Aldehydes (as formal- dehydes)	Ammonia	Nitrogen oxides (as nitrogen dioxide)	Sulfur oxides (as sulfur dioxide)	Acids (as acetic acid)	Organics	Solids
General Public Emissions							
Fuel gas-----	6.5	-	47	--	9	10	-
Fuel oil-----	2.5	-	27	60	27	10	0.5
Gasoline-----	30	4	140	30	3	850	0.5
Refuse-----	3	4	1	2	2	550	-
	42	8	215	92	41	1,420	1
Petroleum Industry Emissions							
Fuel gas-----	9	4	61	84	11	13	0.5
	2.5	-	30	66	30	10	0.5
	11.5	4	91	150	41	23	1
	0.5	0.5	0.2	13	--	--	5
Catalytic cracking-----							
Other Industry Emissions							
Fuel gas-----	4.5	-	32	--	6	7	-
Fuel oil-----	4	-	43	94	43	15	1
Refuse (wood)-----	5	0.2	3	0.5	1	50	-
	13.5	0.2	78	94.5	50	72	1
Totals-----	67.5	13	384	349.5	132	1,515	8

Table 1 lists (by broad sources) some of the materials that have been studied intensively in Los Angeles. This table shows that there are significant contributions to air pollution from the public and from industry.

The data in Table 1 are the results of a survey made in 1950. They do not represent any particular day, and were only an estimate applicable to Los Angeles at the time they were made. Since the Los Angeles area has had a steady population growth of about 3 to 4 percent a year, the data in the table should be increased about 10 percent, assuming that other important changes have not occurred.

One of the more significant discoveries that has come out of the work in Los Angeles is that some hydrocarbons which have hitherto been considered to be relatively innocuous can react in the atmosphere and form new products that cause adverse effects. The sources of these hydrocarbons are from processing and handling operations and, to a very large extent, from the unburned fuel that passes out in automobile exhausts. A 1950 estimate of the origin of some of these materials for the Los Angeles area is shown in Table II.

From this table it can again be seen that the automobile is one of the principal contributors to air pollution.

TABLE II

COMPILED DAILY EMISSIONS OF HYDROCARBONS

Estimated (1950)

<u>Hydrocarbons from</u>	<u>Tons</u>	<u>Percent of Total</u>
Auto exhaust-----	850	53.3
Petroleum productions-----	270	16.9
Petroleum marketing losses-----	90	5.7
Petroleum refinery losses-----	350	21.9
Miscellaneous-----	35	2.2

APPENDIX "B"

"THE NATURE OF AIR POLLUTION IN LOS ANGELES"

DR. A.J. HAAGEN-SMIT: I am the Professor of Bio-Organic Chemistry, California Institute of Technology, Pasadena, and my work on smog is nationally known, reporting on (1) hydrocarbons and their oxidation products, and (2) measurement of smog in the atmosphere.

The air pollution problem in Los Angeles is often compared to that of Pittsburgh, Detroit, St. Louis and other cities. Disasters are cited which took place in Donora, Pennsylvania, the Meuse Valley in Belgium and in Poza Rica, Mexico. These air pollution problems have very little in common with our smog.

HYDROCARBONS AND THEIR OXIDATION PRODUCTS

Chemically speaking, we are faced with an action opposed to that of the reducing sulfur compounds. The most typical aspect of the Los Angeles smog is its oxidizing power. Air bubbled through potassium iodide liberates iodine. Phenols, thio compounds, amino acids and a number of chemicals are changed. Some of these changes can be used as an objective index in recording smog.

It has been shown that the oxidant rises as soon as the sun comes up, and at sundown and during the night the oxidant is very low or absent. Calculated as active oxygen, concentrations of 1.0 part per million have been reached during the peak of a smog attack. This oxidant

consists of ozone, organic peroxides, and nitrogen peroxides. Separate measurements for ozone have shown values as high as 0.5 p.p.m., a concentration which can be detected by odor, and which is able to cause nose and throat irritation in sensitive individuals.

It is usually assumed that only fresh country air contains ozone, and its concentration is usually in the order of 0.03 p.p.m. In inhabited areas, the ozone is reported to be absent. It was, therefore, surprising to find in Los Angeles a concentration of ozone tenfold greater than that found even in the country. The explanation was found in the oxidation of organic material by sunlight and oxygen in the presence of small quantities of nitrogen oxides. In this oxidation, peroxides are formed which add to the total oxidizing effect of the smog air.

It has been shown that these peroxidic oxidation products give plant damage identical with that observed in this area. This damage is easily distinguishable from that caused by sulfur dioxide or fluorides. The fumigation of plants with ozone and gasoline as the source of organic material, or the photochemical oxidation with nitrogen oxides and gasoline lead to the same effect. These experiments have been conducted at concentrations closely resembling those measured during smog periods.

In these fumigations eye irritation is experienced. In addition, aerosols are formed in the oxidation process,

especially when unsaturated ring compounds are present. Fumigations carried out with fractions of gasoline and with pure hydrocarbons have shown that the irritating effects are not due to a single constituent of the gasoline, but that the most severe damage occurs in the fractions containing from four to seven carbon atoms per molecule.

Analytical studies of the composition of smog air have shown the presence of a large variety of hydrocarbons. In mass spectrographic studies carried out by Dr. Shepherd of the National Bureau of Standards a similarity was established between the composition of smog and that of a mixture of hydrocarbons subjected to the action of ozone, nitrogen oxides and ultra-violet light.

Checking the sources of emission of hydrocarbons revealed considerable losses in the processing, distribution and consumption of gasoline. The Los Angeles County Air Pollution Control District established in 1950 that these losses, amounting to 1,500-2,000 tons daily, are about equally distributed between industry and the automobile. Since that time, recovery measures have been instituted at the refineries, and some 200 tons are no longer being wasted through emission to the air. In progress are corrective measures on tanks, separating tanks, emergency releases, etc., as well as on fuel losses in the distributing process. It is now recognized that

many of the corrective measures return a profit and will materially reduce fire hazard. In view of these advantages, coupled with the good neighbor policy on the part of the refineries, we may look forward to a speedy solution of this part of the problem.

Less encouraging is the progress made in the curtailment of the losses of hydrocarbons and their oxidation products from the automobile. On the contrary, the gain made by the petroleum industry has been offset by the increase in the number of automobiles, and their contribution has already surpassed that from the refineries. This trend will continue unless control measures are taken. The visible smoke from the automobile exhaust plays only a minor role. The main offender is the 7 to 10 percent of unburned fuel which leaves the exhaust. Inventors are engaged in devising mufflers which will burn these gases catalytically, and important progress is being made in this direction. However, such devices are not yet ready, and when available, their installation will be a material taxation on the two million automobile drivers in this area. Parallel with the development of these devices should go studies on the more economic use of fuel through improved engine design and carburation, and studies on the production of fuel which is not a potential irritant when released to the air.

The individual can cooperate by keeping his automobile in good mechanical condition, and considering the advantage

of more mileage per gallon when buying a new car. Finally, it is essential that the city planners curb the daily stampede of automobiles and relieve the congestion by working out an efficient mass transportation system. It should be realized that the solution to the smog problem is a technical one. Successful solution depends on the rapid installation of efficient control measures by industry, plus the complete cooperation of a well informed public to reduce as far as possible every known source of air pollution.

MEASUREMENT OF SMOG

Areas which have not yet been affected by air pollution can profit from the experience accumulated in other cities. One of these lessons is that we should be continuously watchful for the impurities in the air. This means that the analytical chemist should make a continuous check on the composition of the air for elements which contribute to air pollution problems.

When the air pollution problem has not reached a stage in which the people are aroused, this analytical work has to be done on a modest scale, and it is therefore essential that the utmost economy be considered in selecting the type and the number of analytical methods to be used. The typical effects in Los Angeles correlate well with the analysis of the oxidant, either by a potassium iodide method or by that using phenolphthalin. Other areas will be affected by dusts or sulfur dioxide. These are the most

common types of air pollution, and it is therefore suggested that if any testing program is set up which will be useful in the future, that the measurement of oxidant, sulfur dioxide and dust be included.

We should not forget that lack of these data taken at an early time makes it very difficult to gauge the effectiveness of any control program. Such data also clearly indicate a trend in air pollution which may persuade the authorities to take a more vigorous action in combatting air pollution.

APPENDIX "C"

"AIR POLLUTION AND LUNG CANCER"

DR. PAUL KOTIN: I am the Assistant Professor of Pathology, University of Southern California School of Medicine, and director of USC's air pollution research, describing briefly some problems involved in setting up the research project to measure the physiological effects of smog on animals and humans. My major comments, however, are based on findings of my previous research work regarding the relationship between air pollution and cancer and, for this summary, I have submitted an excerpt from a paper, "The Current Status of Air Pollution Studies in the Etiology of Lung Cancer" which I presented before a meeting of the American Cancer Society in New York.

The increasing frequency of lung cancer presents several facets which indicate that the atmospheric environment may be etiologically associated with this observed increase. A study of the atmosphere and the sources of man-created pollutants seems especially indicated with the realization that epidemiologically, a disproportionate rise in incidence has been noted in urban population groups by investigators here and abroad, and it is in the urban areas that air pollution is greatest.

CARCINOGENIC HYDROCARBONS

The demonstration of carcinogenic hydrocarbons in the atmosphere and exhaust products, and the production of skin cancers in C57 black mice by the painting of atmospheric extracts is self-explanatory. It is

elaborations are necessary, however, in attempting to explain (1) the high tumor yield in the face of relatively low concentrations of 3,4-benzpyrene in the atmosphere, (2) the low concentration of 3,4-benzpyrene in the air in view of the known high quantitative emissions from vehicular sources and other origins, and (3) a mode of biological activity for the carcinogenic air pollutants in the pathogenesis of human lung cancer.

OTHER HYDROCARBON SUBSTANCES

The demonstration of approximately only 900 micro-milligrams of 3,4-benzpyrene per million cubic feet of air in two successive samples suggests as a reasonable possibility that carcinogenic materials other than 3,4-benzpyrene may be present in the atmosphere. The polycyclic hydrocarbons demonstrated along with benzpyrene in the air are traditionally noncarcinogenic, or of such low carcinogenicity as to preclude any significant biological effect on their part insofar as is known. We have remaining either unknown compounds such as those already demonstrated and designated compound "X" and "Y" or perhaps other unknown aromatic hydrocarbon substances whose carcinogenicity must be assayed. While this will be done, their presence is in trace quantities and so high an order of tumor-yielding potency must be ascribed to them as to make this conclusion unlikely. A second source of carcinogenic activity may be sought for in the oxidation products of atmospheric hydrocarbons both aro-

matic and aliphatic. Haagen-Smit has clearly shown that a chief characteristic of urban polluted air is its marked oxidizing capacity. The phenomenon is capable of acceleration in sunlight and heat. It is of interest to note that biological responses, including eye inflammation, upper respiratory tract irritation and specific leafy plant damage, are attributable to these organic oxidation products. It is this latter botanical property that we use as an indicator of the presence of hydrocarbon air pollution.

EPOXIDE STAGE

In the stages of oxidation of organic peroxides to aldehydes and ketones, the epoxide stage is an intermediate one. Inferentially, a diepoxide stage may be assumed which would provide materials of experimentally demonstrated carcinogenicity in the atmosphere. The presence of epoxides and the chemically assumable diepoxides, in addition to other hydrocarbon oxidation products, are thus in need of definitive investigation, which program is now in the process of initiation. It is of extreme significance perhaps to note that in painting experiments on C57 black mice, using oxidation products exclusively, three papillomas have thus far been produced.

EFFECT ON HYDROCARBONS IN THE AIR

The fate of polycyclic hydrocarbons, in general, and 3,4-benzpyrene specifically following emission into the air, is in need of definition in view of the large quan-

tities of benzpyrene emitted into the atmosphere from gasoline engine exhausts, diesel engine exhausts and refuse incineration sources.

The effects of urban air pollution (smog) and certain of its individual pollutant constituents on the survival of 3,4-benzpyrene has been investigated in a preliminary manner. Benzpyrene may be recovered from 96 to 100 percent following exposure to oxygen, ozone or gasoline separately in chambers. Exposure to nitrogen dioxide resulted in approximately a 40 percent recovery of benzpyrene. Ozone plus nitrogen dioxide, and ozone plus nitrogen dioxide plus gasoline each resulted in destruction of approximately 40 percent of the benzpyrene. Finally, ozone plus gasoline yielded approximately an 80 percent recovery of benzpyrene. Techniques and analytical methods used in the above initial determination, and additional detailed quantitative studies will be recorded in a future publication concerned with efforts to determine the fate of carcinogenic hydrocarbons adsorbed on soot.

EXPERIMENTAL WORK WITH MICE ON LUNG CANCER

A review of the literature cannot but impress one that the experimental production of lung tumors in C57 black mice with respired hydrocarbon has been generally unsuccessful. Experimental painting and clinical hydrocarbon environmental cancers thus far reported have been primarily limited to the skin. Evidence exists that this disparity may be due to the fact that carcinogenic hydro-

carbons are biologically ineffective while adsorbed on soot particles within a given size range, becoming effective only upon elution or displacement from the soot particle. The sebaceous secretions on the skin may provide the lipid solvent to elute the carcinogenic hydrocarbons from soot, while in the lungs no such eluting agent is present.

The foregoing does not preclude, however, an association between air pollution and lung cancer when an external eluting agent is present in the atmosphere in combination with soot. Primarily under urban conditions, but also in rural areas, gasoline vapors and more significantly their gaseous oxidation products in aerosol form, are present in combination with soots allowing for the simultaneous breathing of the components. A solvent has thus become available to extract aromatic polycyclic hydrocarbons from soot so as to allow their activity on the respiratory mucosa. This liberation of, for example, 3,4-benzpyrene - one of the polycyclic - from the soot to which it had been previously harmlessly adsorbed, permits its local action with resultant theoretically possible cancer initiation.

PARTICLE SIZE OF POLLUTANTS

An additional factor which may also be of considerable significance is that of the particle size of pollutants in the air, since settling on the respiratory mucosa is obviously necessary for carcinogenesis. Aerosol particles, lying in the range between those large particles

incapable of passage distal to the upper respiratory tract and those small particles which remain suspended in the tidal air, are present in urban polluted atmosphere.

FACTORS RELATED TO INCREASE IN LUNG CANCER

Much of the interest in the present study stems from some of the geographic and epidemiologic aspects of the increase in lung cancer. It appears that there are (1) differences in the starting periods from which the increase may be assumed to have begun, (2) variations in the incidence in the two sexes from country to country, and (3) different rates of acceleration of incidence in various localities. These characteristics are capable of correlation with the incrimination of the atmosphere as a pathogenetic factor in the increased incidence of lung cancer on the basis of studies of Hueper, Steiner, et al., Stocks, and Kennaway. Not only has urbanization and industrialization been nonuniform in its development, but the rural distribution of urban-created and to a lesser degree rural-created air pollutants require studies from the point of view of frequency of contamination and dilution of the contaminants.

CONCLUSIONS

In conclusion, it is again suggested as a reasonable possibility that the numerous unanswered questions relative to the causes of the increasing frequency of lung cancer are more capable of being answered by the incrimination of the atmosphere rather than any other agent including

tobacco. The way for additional studies has been indicated by our studies

It is of extreme significance to recognize that, first, air pollution as it exists in Los Angeles, the site of our study, exists in all probability in all large urban communities as determined by the use of phytopathologic indicators as well as chemical analysis. London, Zurich, Copenhagen, San Francisco, New York, among other cities have all shown pathognomonic "smog" damage to plants. Quantitative differences do exist. Second, 3,4-benzpyrene is probably but an indicator or thermometer for the presence of carcinogenic substances in the atmosphere. Third, gasoline and more significantly its oxidation products, although in themselves noncarcinogenic, give strong suspicion of being involved in the pathogenesis of human lung cancer. Fourth, aliphatic hydrocarbons and their oxidation products need study to assay any inherent carcinogenic properties possessed by them. Fifth, the sources of known carcinogenic hydrocarbons have been shown to include not only vehicular exhausts, but also home and commercial refuse incineration and railroad diesel effluents. Finally, it is suggested that in those areas showing a lagging increase in lung carcinoma frequency, correlation with lagging industrialization, use of gasoline motive power and urbanization seem demonstrable. This is offered as an alternate explanation of the findings of Dungal.

APPENDIX "D"THE LEAF STRUCTURE OF POA ANNUA WITH OBSERVATIONS
ON ITS SMOG SENSITIVITY IN LOS ANGELES COUNTY

Ruth Ann Bobrov

ANNUAL BLUEGRASS (*Poa annua* L.), introduced from Europe, is now widely distributed in open fields, lawns and waste places throughout the United States, Newfoundland, Labrador and Alaska (Hitchcock, 1951). It enters lawns as an impurity in the lawn seed mixture, grows luxuriantly for a while and dries up following a short spurt of growth (Robbins et al., 1941). Typically short-lived in any environment, the death of *Poa* in Los Angeles County is probably accelerated by its extreme sensitivity to atmospheric smog; hardly a blade can be found growing in this area free of smog-damage markings.

The chemical mechanisms of smog formation (the studies are not yet complete), the increasing control of smog, and its physiological effects on vegetation have been described in previous publications (Los Angeles County Air Pollution Control District Reports, 1949/50, 1950/51, 1954). Investigations to date indicate that smog is a complex of liquids, solids and gases comprising more than 50 chemical elements and compounds,

and produces, among other effects, low visibility, eye irritation, crop damage, excessive rubber cracking and odor nuisances. The damage of plants by smog is considered to be due to certain intermediate products (the chemistry of these products is not completely determined), resulting from the chemical combination of unsaturated hydrocarbons with ozone (Haagen-Smit et al., 1952).

While no satisfactory series of chemical or physical tests of the atmosphere has yet been devised which can detect all these irritating, toxic agents, it appears that living plants may serve as biological indicators of their present in the air.

Intensive investigation of crop damage by smog in this area began in 1947 and was reported in print for the first time in 1949 (Los Angeles County Air Pollution Control District Report, 1949/50; Middleton, 1950; Went, 1950b; Thomas, 1951). Certain species of vegetables, ornamentals and weeds have been shown to be singularly sensitive. Among the vegetables most severely damaged are: *Lactuca sativa* (lettuce), *Cichorium endivia* (endive), *Spinacia oleracea* (spinach), *Beta vulgaris* (swiss chard), and *Avena sativa* (oats). Susceptible ornamentals include: *Petunia hybrida* (common garden petunia), *Antirrhinum majus* (snapdragon), *Callistephus chinensis* (china aster), and *Dahlia pinnata* (common or garden dahlia). In the field, the following

weeds are conspicuously sensitive: *Poa annua* (annual bluegrass), already mentioned, *Stellaria media* (common chickweed), *Rumex* sp. (dock). *Chenopodium album* (lamb's-quarters), *Malva borealis* (bull mallow), *Galinsoga parviflora* (galinsoga), *Avena fatua* (wild oats), and *Amaranthus deflexus* (low amaranth). Field observations have been carried on for several years and a sensitivity file has been kept in which has been noted the date, place of collection, and gross and microscopic appearance of damage to each plant. These observations are of some assistance to the meteorologists, in that they indicate possible sources and spread of air pollution in the County.

Poa annua has been singled out for study as a biological indicator because, as far as present investigations go, it is one of the most smog-sensitive plants yet observed. Damage usually appears as a transverse tan band (fig.7) somewhere near or above the midblade of mature leaves, and cellular response even to minute quantities of the oxidation products of hydrocarbons is obvious within several hours following exposure. The present paper deals with a comparison of the leaf anatomy, both normal and damaged, of this plant.

Materials and Methods. Hundreds of normal and damaged plants were studied over a period of two years. Through the courtesy of Dr. F. W. Went of the

California Institute of Technology, *P. annua* was grown smog-free in the specially filtered greenhouses of Earhart Laboratory (Went, 1950a). *Poa*, growing in a lawn crowded with other grasses, or growing in a desiccated summer field, is dwarfed (2-4 inches), smog damaged, insect ridden and difficult to section, while Earhart-grown plants are considerably larger (6-7 inches), more lush and therefore provide better study material. Injury was induced repeatedly in Earhart-grown plants by subjecting them to hydrocarbon-oxidation products ("synthetic" smog)⁵ in the laboratory. Such damage was found to be similar both microscopically and macroscopically to damage occurring in the field. The anatomical details of *Poa* described in this paper are derived from a study of normal and experimentally-damaged Earhart-grown plants.

For the sake of clarity, leaves will be considered as young, mature and senescent. Young leaves are the newest, unexpanded, pale-green leaves at the apex of a plant; mature, the second and third leaves from the apex; senescent, those below the third node (fig.2). Such leaves differ anatomically from one

5: Two-tenths p.p.m. of ozone was admitted into the fumigation chamber together with such an amount of gasoline vapor that no free ozone could be detected upon testing. Free ozone must be barred since it is injurious in its own right, producing a type of plant damage distinct from smog damage. Descriptions of the laboratory procedure of fumigation may be found in papers by Haagen-Smit et al..(1952) and Cann et al.(1954).

another in size of cells, intercellular air space, lignification, cuticle thickness, stomatal activity and internal suberization.

The typical monocotyledonous leaf grows from a basal meristem. As the young leaf expands, the tissues pass through the various developmental stages from youth through maturity to senescence. Cellular differentiation proceeds in a gradient from tip toward base. The small compactly arranged cells of the young tissue expand, become lobed, and border enlarged intercellular air spaces. Internal suberization increases, and, with an increase in the ability of the stomata to function, the cells pass into the mature smog-sensitive stage. Further increase in the thickness of the internal suberin membrane, together with reduction in stomatal activity, denotes senescent tissue. In a mature leaf, tip cells are senescent (similar to the cells of senescent leaves), midblade cells mature, and basal ones still embryonic (similar to the cells of young leaves). Damage in such a leaf is restricted to the midblade region.

In an attempt to determine the activity of stomata in normal leaves of different ages, preliminary experiments were carried out by Mrs. M. Vasek (1954, unpublished), in the Plant Anatomy Laboratory at the University of California, Los Angeles. This

work indicated that the stomata were widest open and most responsive in those regions of the plant which were smog sensitive.

Observations of Smog Damaged Leaf. Observations in the field indicate a difference in susceptibility to smog of different aged leaves (Noble, 1954). Senescent and very young leaves are usually not smog sensitive, the former probably by virtue of the extent of the internal suberization which acts as a barrier to damage, the latter by virtue, presumably, of their compactly arranged cells and non-functional stomata. The intercellular air spaces of senescent leaves are lined with an internal suberin pellicle which is at least twice that of young leaves. Usually only mature cells are vulnerable. It has already been pointed out that, in mature leaves, tip cells are senescent, midblade cells mature and basal ones meristematic. Sensitivity to smog differs in these three regions; damage usually occurs only in the localized region of such leaves between tip and midblade. Damage also occurs at the tip of young leaves and the base of senescent ones -- wherever cells have just reached maturity. This distribution of damage is correlated with the gradient of cellular differentiation, cell age and ability of the stomata to open and close. As a result of the destruction of chlorophyll and dehydration of tissue,

gross damage manifests itself as either a tan spotting or transverse band in the susceptible region.

The stomata appeared to function most actively in the midblade regions of mature leaves, somewhat less actively at the base of senescent and the tips of very young leaves, and not at all in those leaf regions which are never smog damaged. This work indicates a marked correlation between vulnerability to damage and degree of stomatal opening since, as previously mentioned, in most instances, smog attacks wherever cells have just completed maturity.

On the microscopic level, the response of susceptible cells is similar to that described for spinach, beet (Los Angeles County Air Pollution Control District Report, 1950/51) and oat (Bobrov, 1952a, 1952b). Immediately after entry of the phytotoxic substances through the open stomata, the cells bordering the substomatal chambers show damage (fig.11). The first visible response of *Poa* cells to smog is the disintegration of chloroplasts which results in the grana lying free in the cytoplasm. This is apparent without staining. Plasmolysis follows almost immediately. Permeability is probably altered and thionin enters the affected cells rapidly. As seen in paradermal section, normal substomatal cells appear turgid and lobed (fig.5). Following exposure, the cells in

the vicinity of the substomatal chambers become dehydrated and, as they shrink, the intercellular air spaces become larger (fig.11). Dehydration proceeds slowly for approximately 48 hr. until the cells are completely "mummified" (fig.6,12). Normal cellular contacts with neighboring cells remain intact as the tissue dehydrates, resulting in a skeletonization rather than a collapse of tissue. The extent of tissue involvement depends upon the concentration of such materials is low, damage remains limited to a small number of cells immediately around the substomatal chambers. Such minor damage appears to the eye as a tan -- each spot representing a small group of dehydrated cells surrounding a stoma (fig.9). Attention has already been called to the delicate structure of the *Poa* leaf which is 5 cell layers at its maximum depth. If the concentration of phytotoxic materials is high, involving the cells around many substomatal chambers, cellular dehydration proceeds through the entire depth and possibly width of the lamina (fig.3), resulting in a tan transverse band in the limited region between tip and midblade of mature leaves and/or other susceptible regions.

Discussion. The explanation for the susceptibility of plants to damage by smog cannot be found in leaf structure alone; specific sensitivity of

a species is also involved. Some plants are less sensitive to smog than others in spite of a leaf anatomy that should predispose them to injury. *Brassica oleracea* (cabbage), for example, has a low specific sensitivity and shows only minor cellular reaction. The reason for this resistance is not known. However, when a plant does possess the requisite high sensitivity, the structure and development of the leaf help explain the distribution and extent of damage. *Poa annua* has a very high smog sensitivity and, this, together with its method of cellular differentiation, makes it an excellent indicator plant. The elongate blade possesses cells of several different ages and degrees of susceptibility. The characteristic transverse banding is definitely related to leaf differentiation, cellular age and ability of stomata to open readily.

Stomata are the portals of entry for polluted air into the leaf interior. The mesophyll cells are arranged in loose fashion around the intercellular air spaces. Smog enters the substomatal chamber through the stomata and may diffuse for short distances into the adjacent intercellular spaces or, what is alternatively possible, may be so rapidly absorbed by the cells surrounding the substomatal chambers as to become ineffective short distances away. The many cell walls bordering the substomatal chambers are the first to be damaged.

Stomatal distribution in *Poa* has already been described. The stomata occur on both surfaces; the stomatal zones are wide with only narrow interstomatal zones. For this reason, almost the entire leaf is open to the atmosphere on one or the other epidermal surfaces or both. Since the stomata are numerous and widely dispersed in a lamina possessing only few cells in depth, leaf damage in response to a high concentration of smog may be severe. However, injury reaches its maximum intensity somewhat above the central region of mature leaves.

A relationship between smog damage and stomatal distribution has also been shown for oat (Bobrov, 1952a). The characteristic longitudinal streaking of oat leaves is correlated with the longitudinal distribution of stomata in narrow zones; these zones are widely separated from one another by large stoma-free, undamaged bulliform or vascular zones. Here also, damage is restricted to some point between tip and midblade of susceptible leaves.

Work is in progress at this time in an attempt to calibrate *P. annua* as a quantitative as well as qualitative bioassay material. "Pure" plant supplies are being maintained by growing *Poa* in air filtered of all smog. When plants have reached a height of approximately five in., they are exposed to an atmosphere in

different regions in and around Los Angeles County for a single day. The extent and distribution of leaf damage is recorded. The width of the damage band is correlated with the concentrations of known phytotoxic agents in the air measured chemically on the same day.

SUMMARY

Annual bluegrass (*Poa annua* L.) is very sensitive to certain phytotoxic agents present in smog and might be useful as a bioassay indicator plant. In the field, the characteristic response to hydrocarbon-oxidation products is seen to be a tan spotting or transverse banding limited to the region between tip and midblade of susceptible leaves. This damage has been duplicated in the laboratory with synthetically-produced smog. Tissue damage is similar to that previously described in spinach, beets, oat and other plants. The cells which are initially and most seriously damaged are those surrounding the substomatal chambers. Chloroplasts disintegrate, plasmolysis follows, and ultimate total dehydration of damaged cells results in part or all of the mesophyll tissue in affected areas becoming "mummified." In plants having a high specific sensitivity to smog, damage is correlated with stomatal distribution and activity, volume of intercellular air space and age of cells. Localization of damage is

related to the gradient of cellular differentiation from tip to base in the linear leaf; the sensitive region is limited to those cells which have just completed maximum expansion.

Los Angeles County Air Pollution Control District,

Los Angeles, California

and

Department of Botany,

University of California,

Los Angeles 24, California.

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APPENDIX "E"

Quotation from

"SOUTHERN CALIFORNIA BUSINESS," Vol. XVII, No. 40, October 3, 1955, sets out the Smog Program of the Los Angeles Chamber of Commerce. After doing everything possible to attract industry to the Los Angeles region for over 65 years the Chamber has now decided to adopt a policy of refusing to permit any new industry to settle in the area if it is going to contribute to the smog problem.

CHAMBER FORMS SMOG PROGRAM

The Chamber's Board of Directors have approved the following program of action to assist in the solution of the air pollution problem:

Premises

We are informed by the scientific authorities who have studied the problem that:

1. The pure air supply of metropolitan areas throughout the world is becoming increasingly polluted as a result of man's activities. The problem in our community is accentuated during periods of inversion.

The very factors, meteorologic and physiographic, which make this climate unusually pleasant, also insure that air movement is sometimes slow, thus restricting the rapid ventilation of the area.

2. The natural forces affecting this pure air supply are so great that there is no apparent way to modify them.

3. A continuation of our present rate of air pollution poses serious threats to living values, business values and property values in the Los Angeles Basin.

4. Therefore, we must limit pollution of the air supply now available to this Basin.

5. The most important contributors to smog, in the order of the size of their contribution, are:

Automobiles and other motor vehicles
Industry
Incinerators.

6. In the light of this knowledge, we should proceed as rapidly as possible in the reduction of air pollution from the three major sources.

7. We believe the citizens of the Los Angeles Basin will support intelligent action to reduce substantially the air pollution from these major sources.

Program of Action

The Los Angeles Chamber of Commerce will work toward the early reduction of smog in this Basin by the following methods:

1. Declare to the automobile industry that this Metropolitan area (and eventually every large city) must have automobiles and other motor vehicles with

vastly improved fuel combustion to prevent the continued exhaust into the atmosphere of increasingly large quantities of hydro-carbons and strongly urge greatly accelerated research and development by the automobile industry to that end.

2. Recommend the establishment by business and industry of ride-sharing plans to operate during the early fall months of greatest temperature inversion.

3. Support studies and early action looking toward the establishment of at least some non-smog producing rapid transit services on major routes which will assist in the mass movement of our people to the principal centers of business and industry concentration.

4. Urge the early completion of air pollution control installations on all equipment now operating under variance.

5. Support a policy that new industries to which adequate smog control devices cannot be applied, shall not be permitted to locate in the area.

6. Urge and support the early inauguration of area-wide collection and disposal of combustible rubbish.

7. Continue to support the most competent research, seeking a more conclusive understanding of the conditions which form smog and of the practicable means of reduction in smog forming emissions to the atmosphere from all sources in the Los Angeles Basin.

8. Review these recommendations periodically in the light of experience and knowledge as developed by competent public and private research.

Important Progress to Date

It is recognized that the automobile industry is expending very great sums of money for research and development of improved fuel combustion.

It is also recognized that a great many industrial establishments throughout the area have already expended large sums to reduce air pollutants from equipment now operated under variance; also that many industries which are now operating in compliance with existing law and air pollution rules and regulations are nevertheless actively and coluntarily still expending large sums to further reduce air pollution wherever it exists.

Progress has also been made by householders and some communities in the collection and disposal of combustible rubbish.

But in all of these things, there is urgency for greatly accelerated action.

The purpose of this program is to stimulate that action. We know it can succeed if the people of the community will give it wholehearted support.

Request for Cooperation

We urge that civic, commercial, industrial, service and other organizations in the Los Angeles Basin give maximum attention to the smog problem and join in a united attack along the lines herein recommended.

We further urge that all such organizations in the Los Angeles Basin join in a united effort to promote the best possible understanding by the citizens of the Basin of the causes of smog and the problems involved in its control, including an understanding of the time required to perfect correction.

We have worked in cooperation with others in the earlier phases of this smog problem -- to promote research, legislation and the initial control activities. This policy statement is designed to further implement the joint efforts of the community and to stimulate increasingly vigorous action.

We are ready to work wholeheartedly with any responsible organization in an organized program of action to rid this area of smog.

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APPENDIX "F"

Excerpts from Report of

Dr. Lauren B. Hitchcock, President and Managing Director,
Air Pollution Foundation, Los Angeles, California, U.S.A.

I would now like to present to you the key men
on our staff:

Dr. W. L. Faith, Deputy Director and Chief
Engineer, Dr. M. Neiburger, Senior Meteorologist, Dr. N.
A. Renzetti, Senior Physicist, Dr. L. H. Rogers, Senior
Chemist, Burt Leiper, Public Information Officer, and
Robert S. Weatherly, Business Manager.

The first problem which confronted us was to
decide what the outer limits of our Los Angeles atmos-
phere were -- that is, just what is the land area and
amount of air over it, which are critically affected.
At the start we found that it was loosely described as
the City of Los Angeles, or Los Angeles County, or a
basin of 1100 or 1200 square miles in extent. Careful
meteorological study indicates that the critical area
is about 1630 square miles and the critical atmospheric
volume one which exists under low temperature inversion
layers ranging from surface inversions to perhaps 2000
feet. We chose as a typical height to the base of this

inversion layer an altitude of 1200 feet.

Activities in Our "Air Chamber"....

In studies recently completed for us by two members of the University of Southern California faculty, Ballary and Goedhard, the current population in this Basin is estimated at 5,030,000. Of the 1,630 square miles total in the Basin, 1145 are in Los Angeles County and 485 in Orange County, or exactly one-third of the total area in these two counties, in which reside about 98% of the total population of both counties.

Within this limited air chamber we have currently a total of 2,361,000 motor vehicles, according to our investigators Ballard and Goedhard, burning a total of 4,680,000 gallons of gasoline per day or 14,040 tons. There is no accurate information on the number of domestic incinerators nor of the amount of rubbish burned in them, but exhaustive research by them suggests as a rough guess about 1,500,000 such incinerators burning about 5000 tons per day.

Imperfect Combustion....

Within this same area we have tremendous industrial activity. We have installed through-put

capacity for refining about 39,000,000 tons of crude oil per year. We have capacity for steel production of $2\frac{1}{4}$ million tons per year as the largest steel-producing area west of Chicago. We have the generation of power for industry and for our homes, for which we have a choice of two hydrocarbon fuels, natural gas and fuel oil. In our automobiles we have a third hydrocarbon fuel that is called gasoline. All told the 5,000,000 and their industry in this restricted air chamber burn over 50,000 tons of fuels and rubbish every 24 hours. This in itself would not be serious, but unfortunately all of these combustion processes are imperfect, some more so than others. Preliminary indications are that over 3000 tons per day of unburned fuel or partially burned fuel plus oxides of nitrogen and sulfur result from our combustion processes, excluding carbon dioxide, carbon monoxide, dust particles and soot. Carbon monoxide is probably in excess of 6000 tons per day.

These pollutants have many sources scattered over our Basin. They come from automobiles, incinerators and industry, with industry contributing about one-third. All available research work of others indicates that on the average 7% of gasoline supplied to motor

vehicles comes out of the exhaust pipe unburned with additional quantities escaping from carburetors and crankcases. Based on the normal consumption of gasoline in the Los Angeles Basin, it is a matter of simple arithmetic to calculate that this source contributes about 1000 tons per day of hydrocarbons, plus organic acids and aldehydes, plus about 300 tons of oxides of nitrogen and sulfur. This is not a matter of opinion. The automotive industry recognizes the automobile as the largest single source of hydrocarbons in our atmosphere. Competent scientific evidence is mounting to show that automobile exhaust gases in the concentrations found in our atmosphere are capable of forming ozone and may be considered a definite source of smog.

Further confirmatory work appears to be needed before there is substantial agreement by all concerned on the cause-and-effect relationship between these various pollutants and the formation of smog. This research is one important part of our program.

Aerometric Survey....

Now, I would like to tell you briefly about a few of the most important projects on our research program. As you will see from the accompanying Tables, the biggest single program this year and next is the Aerometric Survey. This is an intensive analysis of

our atmospheric environment, including analyses of the air for contaminants at various locations and a correlation of air composition with known manifestations of smog, i.e., eye irritation, plant damage, reduced visibility and high oxidant content. In addition to ten stations in the Basin are one in Santa Barbara for control purposes, and one in Riverside, about 50 miles inland. The current survey of four months began in August. We are measuring up to ten variables, but due to limitations of money and manpower, have not been able to do all measurements at all stations this year.

We are also sampling the air at various heights above some of the stations. With the cooperation of the U.S. Navy, we have done sampling from a Navy blimp.

Air Tracer Survey....

In order to follow the movement of polluted air masses, it is of course essential to have complete meteorological data. Accordingly, through the cooperation of the District, we have records from 52 wind stations throughout the Basin. In order to verify our method of calculating wind trajectories, we have been carrying on a program of air tracer tests in which fluorescent particles are released in one corner of the Basin and the movement of air charted by collecting and

counting these particles on a system of filters, located on a 25-mile arc with a radius of about 13 miles. Six air tracer runs have been made this summer. Present indications are that the accuracy of calculated wind trajectories can be improved by having more wind observations aloft.

Refinery Emissions....

You will note that we have now discussed or explained briefly all of the projects in Table II except the refinery emissions audit. This has just been completed and I am glad to be able to make this first report to you today. It became obvious to us some months ago that one of the most controversial and possibly significant sources of pollution in this Basin was the emissions of hydrocarbons from refineries. We made up our minds that an absolutely independent audit should be made. A nationwide search by the Foundation resulted in the choice of the Southwest Research Institute of San Antonio, Texas, as a competent and impartial auditor. Under the direction of Dr. Judson Swearingen, a recognized authority, but who has never been in the employ of any petroleum company, a personal and physical check of all hydrocarbon losses was made in all of the major refineries in this Basin and in typical, small, independent refineries. Hundreds of samples were collected by South-

west Research Institute and analyzed under their supervision. Capacities of storage tanks and characteristics of other equipment were determined independently by them. We believe our survey has been more thorough than those made by the petroleum refineries themselves. The findings of the Southwest Research Institute may be summarized as follows:

The total hydrocarbon emission to the atmosphere in the Los Angeles Basin is estimated at 251 tons per day. The difference between this figure and the 224 tons per day reported by the Western Oil and Gas Association in March, 1954, is believed to be within the range of error to be expected in these types of estimates. The olefin losses of amylenes and heavier are placed at 16.4 tons per day compared to 12.2 tons per day reported by the Association. This audited value for olefins was based on the best available average annual composition of motor gasoline produced and marketed in Los Angeles County as of August, 1954, an analysis which was not available in comparable form in March of this year.

The audit covered nine major and eleven independent oil companies in Los Angeles County and included personal inspection of oil fields producing 52% of the County's annual oil production, refineries possessing

95% of the County's refining capacity, and all bulk and marine terminals. Examination of plant records, interviews with technical personnel, inspection of facilities, and collection and analysis of samples were performed and the calculated results are believed as accurate as can be obtained without very extensive and elaborate studies.

TABLE I

(Research Programs (Summary))

	1954 (6 mos.)	1955
Meteorology	\$ 46,800	\$ 62,000
Chemical Research	71,400	252,500
Combustion Products	32,800	422,850
Aerometric Survey	253,000	616,550
Sources of Pollution	10,500	50,000
Physical Research	<u>2,000</u>	<u>185,000</u>
Total	\$416,500	\$1,589,400

TABLE II

Projects Completed in 1954

Meteorology Report	\$ 3,000
Air Tracer Survey	36,760
Conferences:	
Meteorology	890
Hydrocarbons, Ozone, Mass Spec.	2,000
Vehicle Combustion Products	2,800
Refuse Disposal and Air Pollution	3,000
Aerometric Survey	225,000
Refinery Emissions (Audit)	<u>8,000</u>
Total	\$ 281,450

TABLE III

Project Started in 1954, Continuing in 1955

	<u>1954</u>	<u>1955</u>
Inversion Modification	\$ 6,000	\$ 4,000
Smog-Forming Reactions	60,000	126,000
Infrared Absorption, Long Path	2,000	3,000
Photochemical Reactions	7,500	30,000
Composition of Auto Exhaust	26,000	37,850
Composition of Incinerator Gases	2,000	25,000
Interpretation of Aerometric Survey	30,000	25,000
Sources of Pollutants	4,000	50,000
Spectral Radiometry	<u>7,000</u>	<u>20,000</u>
Total	\$144,500	\$ 320,850

Summary of Our Present View....

To summarize, we got organized in the first four months and underway with a research program in the second four months. While not yet in a position to announce conclusions, we have evaluated available information to the point where we feel we are beginning to see the over-all problem in good perspective; for instance, that our air pollution has two primary aspects, gross pollution by many substances, and under certain conditions transient eye-irritants, plant-damaging compounds, etc. The two may or may not be closely connected. The reduction of one may not necessarily reduce the other. Together they constitute what

is popularly called smog but most commonly identified by eye irritation, reduced visibility, and odor. Gross air pollution may not be physiologically harmful, but we assume it is. Further, it is beginning to look to us as if the contribution of pollution from industry, substantial as it is, is about half the contribution by the public through its automobiles and incinerators; that further identification and diagnosis of these still very qualitative estimates is essential; that the solution will require development of practical, workable remedies, because we cannot prohibit essential activities until there are workable and acceptable alternatives; that there is every reason to believe these remedies can be developed; that it is going to take concentrated effort of industry, government and private agencies on a scale more comparable to wartime effort than the typical peacetime civic welfare movements, and that this Foundation, unique in the air pollution field, is in an excellent position to catalyze this effort, contributing only so much of its own research as will stimulate and guide those who have the basic responsibility and the large resources.

Cost of Other Necessities....

From time immemorial, one thing man has always had plenty of the world over is air. "Free as air" has

been a household word. In the Los Angeles Basin for natural reasons, so far as we know completely beyond man's control, our air supply is limited -- at times severely. Air is no longer free here and there is not enough of it. Consider a moment our other indispensable human necessities here: water, one of our most valued resources which we almost take for granted, represents an investment for the Los Angeles Basin of somewhere around \$750,000,000. There is no great clamor over whether or not we should have potable water, and we shall probably have to have more of it. Take sanitary sewage disposal. Would we contemplate for a moment going back to the days of medieval London where refuse of all sorts was thrown in the streets? In the Los Angeles Basin we have invested perhaps 250 to 300 million dollars in our sewage system. Our highway system in Los Angeles Basin represents an investment of several billion dollars. Our harbor cost us 97 million dollars. How much is tolerable air worth to you people in this Los Angeles Basin? We don't know what the cost will be yet, but we strongly suspect it will be more like some of these other indispensable services which you already enjoy. We recommend the attack for the next 12 months on the 2 million dollar scale. This is one cent a week for every person in the Los Angeles

Basin. How badly do you want tolerable air?

We in the Foundation are here because we believe this job can be done. But a five-man scientific team, even if they were all Nobel prize winners, cannot do it alone. The Air Pollution Control District cannot do it alone. Government cannot do it alone. Citizens' Committees cannot do it alone. It requires a concerted, all-out, united effort. The problem is still with you because only now has its magnitude even been faintly understood, because many hoped for short cuts, because there are still faint hearts in the community, and all this spells failure. We ask your help -- we ask for your united support -- and we tell you this problem can be licked. You have our recommendations. The solution IS possible -- but not on a part-time basis!

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Governor Goodwin J. Knight

on Smog:

"I am convinced we will be successful so long as we recognize that it is a problem to be solved by engineering and scientific endeavors and not by political sound and fury."

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P R O C E E D I N G S

OF THE

SELECT COMMITTEE, APPOINTED BY THE ONTARIO
LEGISLATURE, TO ENQUIRE INTO CERTAIN MATTERS
AND LEGISLATION REGARDING SMOKE CONTROL AND
AIR POLLUTION, IN ONTARIO.

Mr. A. H. Cowling, Chairman,
Presiding.

Dr. Frederick Evis, Secretary.

—0—

VOLUME VI

Thursday, October 6th, 1955.

Los Angeles, California.

—0—

R. C. Sturgeson,
Official Reporter,
Parliament Buildings,
Toronto, Ontario.

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S I X T H D A Y

Los Angeles, California,
Thursday, October 6th, 1955,
8:15 o'clock, a.m.

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The further proceedings of this Committee
reconvened pursuant to adjournment.

Mr. A. H. Cowling, Chairman,
Presiding.

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PRESENT:

Messrs. Brandon, Q.C.,
Elliott,
Thomas (Oshawa),
Gordon,
Hon. Mr. Kelly,
Dr. Frederick Evis , Secretary.

APPEARANCES:

Mr. H. A. Belyea,
Mr. K. L. Grant)
Mr. J. L. Venturini) Bethlehem Steel Company.
Mr. C. A. Kolosseus General Motors
Dr. A. J. Haagen-Smit, Professor of Bio-
Organic Chemistry,
California Institute
of Technology.

AT THE BETHLEHEM STEEL COMPANY, LOS ANGELES,
CALIFORNIA

K. L. G R A N T

appearing before the Committee, but not being sworn,
deposes and says:

BY MR. BELYEA:

Q. You are a professional engineer, with the
Bethlehem Steel Company?

A. Yes.

Q. The collector unit we are observing is for
collecting the effluent from three electric furnaces?

A. Yes, it is. This is the Cottrell type of
precipitator.

Q. These electric furnaces which use the
electronic precipitators in the plant, are to refine
the steel?

A. That is right.

Q. And in doing this, there is a high temperature
of how much?

A. Right underneath the electrons, it may go as
high as 5,500 degrees.

Q. And added to that high temperature, there is
a very high quantity of gas which contains fine particles
which range down to microns of less than 90 percent.

variation, from 1 to 10 microns?

A. Yes.

BY DOCTOR EVIS (Secretary): If you were to breathe it in, it would go into the depth of the lungs?

A. That is right.

BY MR. BELYEA:

Q. About ten years ago, when there would be a flood, there would be an effluent around the plant, flooding the district?

A. Yes. This particular unit (indicating) is all electric. We had open hearths here primarily, and we put in the electric to conform to the smog problem with which we have been confronted in Los Angeles.

Q. You could control a unit of electric much easier than the open hearth?

A. Yes. This unit (indicating) was designed for 169,000 cubic feet per minute, but we are operating it at approximately 110,000.

Q. The previous open hearths, without the unit would flood the district?

A. Yes.

BY DOCTOR EVIS (Secretary):

Q. What would it do, without the precipitator?

A. Let us put it this way; we collect today an average of from 12 to 15 tons per day under operating conditions.

Q. Which otherwise would have gone into the air?

A. Yes.

BY MR. BELYEA:

Q. Is there still sufficient so it can be visible for several hundred feet?

A. On the outside all you can see now is steam.

Q. An extremely small amount of steam?

A. Yes. We use very little coal, which is judged by the temperatures. The mixture is changed as we go along, depending on the temperature. If the temperature is 58 or 60 in the morning, and there is a drop, you will get a condensation in the gas, and that is where you get the vapour.

Q. The law requires a capacity test, as well as a loading test?

A. Yes.

Q. That means you should be able to see through it?

A. The law requires readings, and you cannot exceed the Number 2 Ringelmann for a period not to exceed three minutes in any one hour.

BY DOCTOR EVIS (Secretary):

Q. You would never get a Number 1 Ringelmann?

A. Never.

MR. VENTURINI: You might have the best equipment in the world, but perhaps you may have a short in the unit, and then Mr. Grant will shut it down until repairs are made.

BY DOCTOR EVIS (Secretary):

Q. Aside from an emergency breakdown, you have no contamination coming out?

MR. VENTURINI: No.

BY MR. BELYEA:

Q. In coming to this type of unit, had you considered other devices?

A. We had a rotoclone type of unit previous to that, but our efficiency of recovery was all the way down to 20 percent, and to meet the law here, you have to recover at least 90 or 92 percent. at all times.

Q. Did you try any other type?

A. Then I went to this type. It was purchased through the Western Precipitator, but actually it is a Cottrell unit.

Q. Where is their main office?

A. They have many branches in the western part of the United States.

Q. Where do they actually do the manufacturing?

A. I do not know, but I can find out. They were out here yesterday. All their salesmen had a meeting from all over the United States, and they came out here.

Q. Would you say that five years ago, a plume such as this (indicating) would be almost impossible?

A. Yes, and we are still in the development stage. You must remember there are different industries in this locality, especially the oil refineries.

BY DOCTOR EVIS (Secretary):

Q. Can we get some estimate of the cost of this control equipment?

A. I think each collector cost about \$1,600.

BY MR. BELYEA:

Q. For how many cubic feet?

A. It is designed for 169,000 cubic feet.

BY DOCTOR EVIS (Secretary):

Q. And you put out 110,000?

A. Yes.

Q. So the cost is approximately about \$5.00 per cubic foot?

A. Yes.

Q. That is quite a high rate.

A. It is.

Q. The usual collector is around \$3.00.

A. From \$3.00 to \$3.50.

Q. In most places they are satisfied with a collector which costs about \$2.00.

A. Yes, but they are not new collectors.

MR. VENTURINI: Prior to the installation of this precipitator, the conditions under which the men had to work were atrocious. When the open hearths were installed, you would wonder why the men stayed around at all. Now there is no smoke coming out at all, because it all goes into the precipitator.

MR. GRANT: And eliminates the fumes from the top of the furnace.

MR. VENTURINI: And it pays dividends for the Company.

BY MR. ELLIOTT:

Q. It was developed to make your plant operate more effectively?

A. That is right.

---Messrs. Grant and Venturini retired.

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AT THE GENERAL MOTORS PLANT, LOS ANGELES,
CALIFORNIA

C. A. K O L O S S E U S

appearing before the Committee, but not being sworn,
deposes and says:

THE WITNESS: Gentlemen, the incinerator is designed for 6,000 pounds per hour, with a 50 percent. net load in any one-hour period, and 8,000 pounds, for a 30 percent. overload, in any one-hour period.

We are burning at the present rate of production, 58 units per hour, approximately 9,500 pounds per hour. Some hours we might burn 9,000 and the next hour burn 10,000, and the next hour perhaps 8,500 and then perhaps 10,500. It depends on how fast we can push up our furnaces.

The incinerator, being designed for 6,000 pounds, and 30 pounds per square foot, grate load.

The incinerator contains four chambers. It has the primary chamber, and a chamber into which the debris is injected into where it is burned, and the gas from the primary chamber passes over a breaching into the secondary, which is supplemented by, I believe it is, two 50,000 BTU burners.

These burners operate when the temperature

is less than 1,200 degrees. The reason for that is to burn the carbon out of the gases to comply with the smoke-control regulations.

When the chamber registers 1,200 degrees, these burners automatically cut out.

Particles from the gas go into the settling chamber where they are forced in a circular motion and slowed down to allow a percentage of the particular matter to settle. As the gas leaves the settling chamber, it goes into the water washing chamber, where the remainder of the particular matter is washed out of the gas, and the gas temperature is reduced from approximately 2,000 degrees down to 500, and is exhausted into the atmosphere.

That is basically the function of the incinerator. There are a number of electrical aspects about which I have not told you, but I will be happy to give you the figures we have on hand here.

MR. BELYEA: What is it you burn?

MR. KOLOSSEUS: We burn wood and cardboard.

BY MR. BELYEA:

Q. Waste material, packing cases and so forth?

A. Yes, and packages. We get a terrific amount of glass from Libby, Owens and Ford, and we burn the glass crates.

Q. Have you any oily material, or anything of that nature?

A. Yes, we burn rags, and other similar things. We also burn the paint sludge.

Q. Which is a tough material to burn?

A. Yes, that is true. We have a sludge burner designed, and we have a permit to proceed with the installation. Presently, I am throwing the sludge into the incinerator in barrels, and allowing it to burn itself out.

Q. It is not uniform moisture like you get in a garbage collector?

You get heavy concentration, one of which is gaseous, and the other will be for articulate matters?

A. Yes. We burn approximately 3,500 pounds of cardboard per hour.

Q. Do you put the cardboard in along with other materials?

A. We feed everything into the incinerator, as it reaches the incinerator.

Q. Do you get the necessary combustion?

A. Yes. If the incinerator calls for more air, it gets it through the grating, and the nozzles we have in the wall going into the second chamber,

from the upper chamber.

Q. Is it in the first or second chamber only?

A. Yes, there is the first chamber, and the only control we have is over the discharge by natural gravity.

BY DOCTOR EVIS (Secretary):

Q. Did you mention the temperature of the burners coming on?

A. Yes.

BY MR. BELYEA:

Q. What regulates the temperature?

A. It is based on an electric eye, that is in transition between the settling chamber and the scrubber.

Q. Would that be an extra special control? Is it a special fan?

A. The control is handled manually. The man controls it manually from his work station.

Q. He opens and closes the fan according to the temperature?

A. Yes.

Q. And the smoke indicator is easily visible?

A. Yes. I tried a device for making it automatic, but there is a considerable heat involved.

Q. What is the temperature?

A. From 1,700 degrees on, in the primary chamber.

In the secondary, it gets up above that, to around 2,800.

Q. The secondary completes the combustion?

A. Yes.

Q. And the third --

A. Settles it.

Q. And the fourth burns it?

A. Yes.

Q. And the outlet stack, when it is operating -- can you see anything from it at all?

A. No.

Q. If you look up against the sky?

A. All you could see would be heat waves -- no plume. That is one of the amazing things. We felt we should have a white plume coming off the stack.

Q. That is a condition which five years ago nobody believed possible?

A. Yes. We have this gas being forced through a small opening into a big chamber.

Q. And you still have complete combustion?

A. Yes. It took a little time to instal it.

Q. Are there many others in Los Angeles which have this?

A. There are other incinerators. However, I do

not know of any multiple-chamber incinerators.

Q. This is the only one?

A. That I know of.

Q. Have you had any difficulty in maintenance?

A. Yes, we have had a little, but that is attributable to the fog.

Q. From overloading?

A. Yes. We are replacing the brick between the primary and the second chamber. We have such a terrific load in there that it forced so much material through the incinerator, that it just could not operate.

Q. Have you any information as to the life of these (indicating).

A. "I would say two years. This incinerator (indicating) is designed for a nine-inch fire brick, and four-inch air gap, and four inches of insulation brick, and then the steel casing.

MR. MELLOR: When did you instal this?

MR. KOLOSSEUS: November 21st, 1954, was when we started burning.

MR. MELLOR: Incidentally, the group would like two sets of your plans, specifications and pictures.

MR. KOLOSSEUS: I would have to mail them

out. I do not have them on hand, but I would be very happy to do so.

BY MR. BELYEA:

Q. What is the cost of the unit?

A. The cost of the incinerator?

Q. Yes.

A. This (indicating) was \$90,000. That includes everything, from this building (indicating) back over there (indicating).

Q. From the charging plant, going back?

A. Yes.

Q. How is that rated in tons per hour?

A. The cost, you mean?

Q. No, I would like to get an idea of the cost against the number of tons per hour.

A. It is registered at 6,000 pounds per hour.

Q. The cost is in fuel and man hours?

A. Yes.

Q. And the hauling of the ashes off the property?

A. I hope to get a return, with the cost of the metal down.

BY DOCTOR EVIS (Secretary):

Q. Even aside from the greater return, you hope to get a larger savings?

A. Yes.

Q. How much benefit did you receive now? What is the difference in the cost?

A. The difference in cost is about \$1,100.

Q. A year?

A. No, a week.

BY HON. MR. KELLY:

Q. The cost was reduced from \$1,300. a week down to "\$150.00", a saving of \$1,150?

A. That is an approximate figure.

Q. On the other hand, against that you would have the amortized figures in your plant?

A. Yes.

Q. That is a saving of about \$50,000?

A. Yes.

Q. A year?

A. Yes.

Q. You are making money, even with the amortization?

A. Our Company does not figure it that way.

BY MR. BELYEA:

Q. You might estimate between the amortization, and repairs, the unit cost upward of \$10,000 for a year, and that to haul away the material at \$1,300. a week, for 52 weeks, would be upward of \$65,000 a year,

so you will be saving over \$50,000 a year.

A. I would like something understood. This information is not for publication.

HON. MR. KELLY: That is right.

MR. KOLOSSEUS: The firm's name cannot be used.

HON. MR. KELLY: You can say "one plant" or "our plant".

MR. KOLOSSEUS: Eliminate the name of the Company altogether.

HON. MR. KELLY: It will be tabled in the Legislature for 98 members to read.

MR. KOLOSSEUS: I have no objection to that, with the name taken out.

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P R O C E E D I N G S

at a

DINNER, TENDERED BY THE COMMITTEE TO DOCTOR A. J.
HAAGEN-SMIT, PROFESSOR OF BIO-ORGANIC CHEMISTRY,
CALIFORNIA INSTITUTE OF TECHNOLOGY, HELD IN THE
BILTMORE HOTEL, LOS ANGELES, CALIFORNIA, ON THURSDAY,
OCTOBER 6TH, 1955, AT 6:30 O'CLOCK, P.M.

- - - - -

PRESENT:

Mr. A. H. Cowling, Chairman,
Presiding.

Messrs. Brandon, Q.C.,
Elliott,
Gordon,
Thomas (Oshawa),

Hon. Mr. Kelly,

Dr. Frederick Evis, Secretary.

APPEARANCES:

Dr. A. G. Haagen-Smit, Professor of Bio-
Organic Chemistry,
California Institute
of Technology.

- - - - -

DR. A. G. HAAGEN-SMIT: There is a very
strong indication that there was air pollution here

around 1942. That was traced back to a synthetic rubber plant which released butyldiene, which is used in making synthetic rubber, and also butylene.

That was taken care of by a closed system, that is, they cut down on the emissions of these compounds.

Then the eye irritation disappeared, and then after the war -- say in 1945 or 1946 -- the eye irritation appeared again. Of course, during the war, the gasoline was rationed.

BY DOCTOR EVIS (Secretary):

Q. So there was not as much gasoline used?

A. No. After the war, there was an expansion of the oil industry and other industries, and there was also a tremendous increase in automobile traffic, and gasoline consumption.

From that time on, the situation has become worse and worse.

In 1946 and 1947, there was formed the Air Pollution Control District, and they started out by working on the known sources of pollution, such as sulphur dioxide, and dusts from the steel factories, like the Bethlehem Steel, and the Columbia Steel, and you can how nicely that is controlled.

There were some 208 foundries here, and

they have all been controlled, but, nevertheless, the smog has increased, with this peculiar eye irritation, and the odour.

I think the rest of the story you will find described in this little pamphlet, which was prepared for a lecture to the students at the California Technical Institute.

This pamphlet says:

"THE CONTROL OF AIR POLLUTION IN LOS ANGELES

The same meteorological and geographical conditions which made the Los Angeles basin famous set the stage for a serious air pollution problem when five million people and their industries began to crowd this area. The inversion condition, a warm layer of air above the colder, ground layer, prevents dispersal of the pollutants. This layer of polluted air is blown inland by a slow sea breeze during the day, to return frequently at night, carried by an even slower land wind.

Detailed meteorological studies at ground level show that on days on severe smog stagnant air conditions usually prevail during the night and early morning hours, which permit the build-up of pollution. When the inversion~~on~~height is lower

than 1,000 feet, air pollution becomes noticeable; people begin to complain of eye irritation and odor, farmers notice damage to their crops, and a dense haze blankets the area.

The chemical analysis of smog air shows the presence of a great number of materials, among which are sulfur dioxide and dusts, well known as trouble-makers in other industrial areas. Control measures by the Los Angeles County Air Pollution Control District have brought these emissions below the 1940 level, when the word "smog" was still unknown in California. Hundreds of tons of sulfur are now recovered at the refineries, and emissions of metal dusts from foundries and steel mills are largely controlled.

Public burning dumps have been abolished, but private rubbish burning still goes on, and there is considerable opposition to replacing it with more advanced disposal systems. Another needless source of pollution is created by the 'smokers' -- automobiles which, because of poor maintenance, continually emit smoke from their exhausts. But even cars in good condition produce smokes which, by depositing on the

outside as well as on the inside of our houses, raise our maintenance costs. These same deposits are at present causing concern to the medical authorities.

While these visible sources are not responsible for typical smog damage to crops, and the eye irritation caused by them is mostly of a local nature, their contribution to at least one aspect of the smog -- the haze -- already justifies the insistence of the Air Pollution Control District that the numerous small sources of smokes and fumes should be controlled. Anyone desiring clean air should support the authorities in this part of their difficult and often unpopular task, which is essential to obtaining better visibility.

This part of the control program is not expected to reduce considerably the eye irritation felt over hundreds of square miles, nor will it give relief to the farmer, reduce the peculiar chemical odor associated with smog, or prevent excessive rubber cracking in this area.

Chemically, the most characteristic aspect of smog is its strong oxidizing action. The intensity of this oxidizing action correlates

closely with eye irritation and other smog symptoms such as plant damage, rubber cracking, and smog odor. The amount of oxidant can readily be determined through a quantitative measurement of iodine liberated from potassium iodide solution, or of the red color formed in the oxidation of phenolphthalin to the well-known acid-base indicator, phenolphthalein. To demonstrate these effects, it is only necessary to bubble a few liters of smog air through the colorless solutions. A marked color change occurs, indicating the presence of oxidizing materials.

Daily determinations (as in the chart shown) have shown that shortly after sunrise the oxidant rises, and reaches a maximum at some time during the day -- in Pasadena most often from one to two o'clock. At about sundown the oxidant decreases considerably, and it is practically absent during the night. We have been measuring these effects for more than a year, and have found that when the oxidant value passes a certain level, eye irritation occurs.

The chart below shows the fluctuation in the daily maximum recorded at the California

Institute of Technology in Pasadena. The fluctuations are largely caused by meteorological conditions. However, there is a distinct weekly pattern which shows that Sundays are definitely less smoggy than other days of the week, especially Thursdays and Fridays. This phenomenon is not clearly understood. It could be due to reduced activity of industry as well as to a change in the traffic pattern during week-ends.

The value of these records lies in the objective estimation of smog intensity, and when continued, the data will be an aid in judging progress made in smog control.

From these records we can see that the worst smog period this year, from August through October, was not as bad as last year, either in intensity or in duration (hours per day). Nevertheless, the eye irritation level was exceeded in Pasadena during that time on 65 out of 90 days.

The oxidizing action of smog air is due to the release of large quantities of organic material, mostly hydrocarbons, and oxides of nitrogen. When these gases are exposed to sunlight, eye-irritating substances are formed,

and in the fumigation of plants typical smog damage symptoms are produced. At the same time aerosols (pollutants in the air which are so small they do not settle out, but are in stable suspension) are formed and a smog odor is apparent. Plant damage observed in this area is quite different from that caused by sulfur dioxide or fluorine compounds, and its reproduction in fumigations with the photochemical oxidation products of gasoline and nitrogen dioxide (NO_2) was the basis of one of the most convincing arguments for the control of hydrocarbons by the oil industry.

It was interesting that the same damage could be obtained when ozone was mixed with gasoline vapors in the absence of sunlight. In the vapor phase reaction of ozone with olefins present in gasoline we may expect the formation of ozonides and other substances of peroxidic nature, as well as acids and aldehydes. The possibility of producing typical plant damage and other smog symptoms by the oxidation of hydrocarbons either with nitrogen dioxide, air and sunlight, or with ozone, indicated that similar products are involved, and further research has

established that ozone actually is produced in the air by the action of sunlight on organic material in the presence of nitrogen dioxide.

The concentrations of organic materials -- hydrocarbons, aldehydes and acids -- and those of the oxides of nitrogen determined in our polluted air fully account for the high concentrations of ozone found in this area. During severe smog attacks, ozone concentrations of 0.5 ppm., twenty times higher than in country air, have been measured. From such analyses the quantity of ozone present in the basin at that time is calculated to be about 500 tons.

Since ozone is subject to a continuous destruction in competition with its formation, we can estimate that several thousand tons of ozone are formed during a smog day. It is obvious that industrial sources or occasional electrical discharges do not release such tremendous quantities of ozone. A transport of ozone from the upper air is also out of the question during inversion conditions.

The mystery of the abnormally high ozone content of smog air was solved several years ago, and our discovery that photochemical oxidation

of organic material is accompanied by ozone formation gave further scientific evidence for the necessity of controlling hydrocarbon emissions. It also made clear why the oxidant values rise during the day and decrease as soon as the day is over. Ozone, a major part of the oxidant, is generated in the presence of sunlight, but as soon as this production decreases in the evening, the reactions which destroy ozone gain the upper hand and rapidly remove it from the atmosphere. The eye-irritating reaction products, however, can often be noticed in the air for a much longer time.

The photochemical formation of ozone is also responsible for the severe rubber cracking observed in this area. Rubber is an unsaturated hydrocarbon, and its reaction with ozone is similar in principle to that of ozone and the unsaturated components present in gasoline. We have used the cracking of standardized rubber as a convenient and highly specific test method for the estimation of ozone in the air. During severe smog initial cracking appears in about four minutes, as compared to an hour or more required on smog-free days, or at night.

In duplicating the photochemical ozone formation in the laboratory, known concentrations of hydrocarbons and nitrogen dioxide were exposed to artificial light and the ozone formed was measured by the rubber cracking method or by chemical means. It is found that for a given hydrocarbon concentration -- for example, three parts per million -- a small but definite amount of nitrogen dioxide is necessary before ozone can be detected. After passing through a maximum at about 2ppm, of NO_2 , the ozone formation decreases, and is nearly absent at about 5 ppm., as shown in the chart at left for 3-methylheptane.

The results of many measurements at different concentrations of hydrocarbon are presented in the chart above on a logarithmic scale. We can see that the phenomenon of ozone formation is limited to a definite range of concentration of hydrocarbon and nitrogen dioxide, and this is even more striking when a linear presentation is used. The composition of the air in Los Angeles during smog days is in the order of 0.4 to 0.8 ppm. of NO_2 and 1-2 ppm. of hydrocarbon, and falls directly within the range at which ozone formation occurs. The

amounts of ozone formed in laboratory experiments correspond closely to those measured outside.

The phenomenon that ozone formation is limited to definite relative proportions of hydrocarbon and nitrogen dioxide, observed with 3-methylheptane, is apparently quite true for other saturated hydrocarbons, as well as for olefins, and their oxidation products, acids and aldehydes. It has been observed that as the length of the carbon chain increases from four to nine carbon atoms, the ozone-forming capacity becomes greater. Methane, ethane, and propane were found to be inactive. The highly branched hydrocarbon, 2, 2, 3-trimethylbutane (triptane), well known for its anti-knock value and high critical compression ratio, does not form ozone in any appreciable quantities, even upon prolonged irradiation. On the other hand, the unsaturated n-heptene-3 is very active in this respect. The chart at the right compares the relative ozone-forming capacity of these compounds with our standard hydrocarbon, 3-methylheptane. This marked effect of branching and the location of double bonds on ozone formation is being further investigated to

explore the possibility of a change in fuel composition.

From a practical point of view, it is important that the irradiation of gasoline vapors (straight run, as well as cracked) in the presence of nitrogen dioxide also leads to the formation of ozone, and the Los Angeles County Air Pollution Control District has demonstrated the ozone-forming property of air near sources of hydrocarbon release.

The oxides of nitrogen necessary for this reaction are formed in all high temperature combustions through a reaction between nitrogen and oxygen from the air. The main sources are the burning of fuel gas, fuel oil and gasoline, whereby nearly 500 tons of nitrogen oxides are produced per day. No satisfactory way for the control of nitrogen oxides is known yet, and therefore most of the attention is given to the other partner in the smog reaction, the hydrocarbons.

The hydrocarbons are emitted to the air by evaporation from storage tanks and through many activities of the oil industry. The control of these sources is well under way, and about 400

tons of hydrocarbons per day are now being collected which formerly went to waste. The remaining emissions are estimated to be approximately 250 tons per day.

Automobile Exhaust -

The other large source of hydrocarbons is automobile exhaust. The exhaust contains both ingredients for the production of smog -- hydrocarbons and oxides of nitrogen -- and this ready-made irradiation with sunlight.

The exact knowledge of the range of concentration of hydrocarbon and NO_2 where ozone formation takes place was very helpful in showing that automobile exhaust after irradiation gives ozone. The only data required are the hydrocarbon and nitrogen dioxide concentrations in the exhaust sample. Then from the graph on page 15 we can read how far the sample must be diluted to reach the ozone-forming area.

The exhaust of a cruising car contains about 600 ppm. of NO_2 and 600 ppm. of hydrocarbon. A dilution of 600 to 1 brings it into the area of ozone formation. For acceleration exhaust, with its high NO_2 content, a dilution of 1,000 to 1 is necessary. Deceleration exhaust falls

within the area, and idling exhaust contains too little NO₂ to be able to form ozone upon dilution. However, if we mix deceleration, idling and acceleration exhausts, the 'stop-and go' phase of driving, we have a mixture that is equal to that of cruising exhaust, and ozone can be formed.

The important conclusion is that somewhere behind the car the exhaust gases will be sufficiently diluted to form ozone.

More than 4,000,000 gallons or 12,000 tons, of gasoline are consumed each day in the Los Angeles area. To this should be added 30,000 gallons of lubricating oil which are also burned or lost. The loss in unburned or partially burned gasoline from the exhaust is about seven to ten percent of the gasoline used, and it is estimated that the emission of hydrocarbons to the air is on the order of 300,000 to 400,000 gallons, or about 1,000 tons per day.

Driving Conditions in Los Angeles -

The Los Angeles County Air Pollution Control District has determined the gasoline losses during idling, acceleration, cruising and

deceleration. The losses are not equally divided over the different phases of automobile operation. As a result of a survey on driving conditions in Los Angeles, we can estimate the time spent on each phase. Tabulation of these results shows the relative importance of the different phases of automobile operation with respect to hydrocarbon emission.

<u>Driving Condition</u>	<u>Idling</u>	<u>Accel.</u>	<u>Cruising</u>	<u>Decel.</u>
Time Drive--%	18	18	46	18
Gasoline-gal.hr.	0.45	2.25	1.52	1.22
Hydrocarbon Concen. mg./liter	5.8	0.8	0.9	15.0
Exhaust Flow cu. ft./min.	14.2	56.0	28.4	30.2
Hydrocarbons into Atmosphere-units	17	8	13	62

It is interesting to note that although only 18 percent of the driving time is spent in deceleration, 62 percent of the total hydrocarbon loss occurs during that time. Stop-and-go traffic, which includes deceleration, idling and acceleration, contributes 87 percent to the total loss. Substantial improvements in exhaust emission can therefore be expected from a reduction in the number of required stops. The

use of freeways allows a constant flow of a large number of vehicles with a minimum of stop-and-go driving. The construction of freeways is therefore an excellent means towards the reduction of exhaust fumes.

The automobile industry in Detroit is seeking a solution through improvements in engine design, carburetion, etc., and it was recently announced that a 30-50 percent reduction of the hydrocarbon emission would be feasible.

The increase in the number of freeways and the improvements in fuel economy are, of course, most welcome to the driver. This cannot be said for the attempts to reduce the exhaust emission through the use of rather expensive devices on the exhaust. There is a great deal of misconception about the purpose of these gadgets and the conditions under which they have to operate. The removal of carbon monoxide, for example, does not help in the reduction of smog. It is often overlooked for each gallon of fuel consumed, one quart of water and more than half a pound of chemicals are leaving the exhaust. Removal by scrubbers or chemical agents is therefore impractical.

The main ingredients that we want to remove from the exhaust by such devices are of hydrocarbon nature, and the only practical way to remove them is by combustion. At the present time, two so-called 'afterburners' show definite promise. However, considerable time for testing is needed before these muffler-type burners can be recommended for adoption by the two-and-a-half million automobile owners in this area. It is held possible that these mufflers can be installed in the not too distant future on trucks and buses.

Also under way are investigations on the effect of fuel composition on the irritating properties of the exhaust gases. The feasibility of converting at least buses and trucks to the use of LPG (Liquid Petroleum Gas) is being considered, since hydrocarbons such as propane and butane are free from some of the objectionable qualities of gasoline. Our findings that there is a considerable difference in the ozone-forming capacity of different hydrocarbons suggest that investigation of the behavior of individual hydrocarbons might give a lead towards improvement in fuel composition.

We should not forget, however, that the high temperatures which occur during the explosion change these compounds, and that the evaluation of their smog-forming character should be made not only on the fuel itself, but also on the products resulting from its incomplete combustion.

While engineering is in progress on the exhaust problem, everyone can help in the reduction of exhaust emissions by keeping his engine in good mechanical condition, by practicing the driving habits recommended when gasoline was rationed, by supporting the construction of freeways and by urging a greatly improved public transportation system.

In order to evaluate the result of such reduction, we have to refer to our graph showing the ozone formation at different concentrations of hydrocarbon and NO_2 . A more detailed view of the region of concentration measured during the smog is shown below. This graph shows the ozone level reached after four hours' irradiation with sunlight at varying concentrations of nitrogen dioxide and 3-methylheptane. Notwithstanding the use of a single hydrocarbon in these experiments, the values of ozone found

found seem to agree well with those found during smog periods, when not only the concentration of hydrocarbons, but also the concentrations of their oxidation products are used in the computation. This method of computation is necessary because the concentrations of hydrocarbon and NO_2 determined during a smog attack do not represent the initial concentrations. Oxidation is continuously going on, reducing the original hydrocarbon and NO_2 concentrations and increasing the concentrations of aldehydes, acids and other oxidation products.

Ozone Formation -

In the first place, we notice on our graph that the concentration of ozone formed is directly proportional to the product of the hydrocarbon and NO_2 concentrations. An increase of 20 percent in the hydrocarbon and NO_2 will therefore result in a 44 percent increase in the ozone formation, and this might well explain some of the increase in ozone levels during the last five years.

The graph also allows us to predict the effect that will be obtained by a reduction in the hydrocarbon. If the initial concentration

of hydrocarbon is in the order of 2 ppm., and that of the nitrogen oxies 0.4 ppm., a reduction of 50 percent in hydrocarbon will enable us to remain just below the threshold of irritation of 0.1 ppm. of ozone. However, when the NO₂ concentration is 0.8 ppm., a quantity which has actually been found during severe smog, a 75 percent reduction in hydrocarbon (from the original concentration of 2 ppm.) would be necessary to reach the same threshold. Unfortunately, the tendency at present is towards a steady increase in the NO₂, concentration, which demands greater and greater efficiency in hydrocarbon recovery. The alternative is to reduce the NO₂ concentration as well as that of the hydrocarbons.

The sources of smog are well known, and there is general agreement that the control measures taken towards the reduction of dusts, smoke, sulfur dioxide and hydrocarbons were fully justified, and that this program should be continued with vigor.

Vigilance and Planning Needed -

There is every reason to expect that the present difficulty will be overcome. The question

is, however, how long will this improvement last? Every reduction in the harmful emissions from the industrial plants is but a partial one, and a small percentage of the pollutants still escapes into the air. The reduction in the emissions from the automobiles through exhaust devices or improvements in engine performance will probably be, in practice, not much better than 75 percent. The oxides of nitrogen, partners in the smog-forming reactions, have continued to increase at a rate of four to five percent per year without any practical means of their control in sight. This unfortunate fact, together with a renewed, gradually-increasing emission of organic materials, will eventually result in even higher concentrations of the irritants, such as ozone, than we notice today. This toxic agent may then exceed the level which conservative hygienists consider unhealthful. If the present trend continues, we might expect in ten or twenty years a repetition of our unpleasant experiences of today. At that time, however, a further reduction will be considerably more difficult and expensive, and will have to include the control of oxides of

nitrogen.

To insure clean air for the future, the present control measures will have to be implemented by bold civic planning which will include not only the city of Los Angeles, but the entire Los Angeles basin. Plenty of breathing space in the form of spacious parks should be included in the plans, together with the creation of a badly needed rapid public transportation system. City planners and engineers may even have to scrutinize carefully such revolutionary proposals as the relocation of industries and power stations, community air purification plants, and other similar projects which may seem fantastic at this time.

Fresh Air Limited -

We have now received two warnings that our fresh air supply is limited. The first, a wave of eye irritation during the war years, was controlled within a year through corrective measures at a single plant. The second attack of severe air pollution has lasted eight years and involves hundreds of industries and millions of people. We shall overcome our immediate problem, but only constant vigilance and thorough

planning will assure a permanent solution. "

MR. BELYEA: The hydrocarbons and the oxides of nitrogen are dangerous, and irritating? It is just a question of the extent?

DOCTOR HAAGEN-SMIT: I think once you have enough of the oxide nitrogen in, the other things will go, too. That is why I went around the country as I did. There was a good deal of hesitation in doing something with the oxides of nitrogen. The recovery of the hydrocarbons had been taken in, but the oxides of nitrogen were left out, and all my experiments showed that the oxides of nitrogen were important, and our trouble is in the combination of the two.

So, if they reduce the hydrocarbons 75 percent. you can cut down the hydrocarbons to 50 percent., and after the 50 percent., you have reached the same thing. But I am pretty certain that to reduce the 50 percent. of hydrocarbons is not enough, because we are growing steadily, and while the present 75 percent. may be sufficient, it will not be in another five years.

It is like the freeways. You want one today, and you have to have another one in five years.

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---Whereupon the further proceedings of this Committee adjourned until Friday, October 7th, 1955, at 9:00 of the clock, a.m.

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ONTARIO

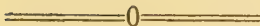
P R O C E E D I N G S

OF THE

SELECT COMMITTEE, APPOINTED BY THE ONTARIO
LEGISLATURE, TO ENQUIRE INTO CERTAIN MATTERS
AND LEGISLATION REGARDING SMOKE CONTROL AND
AIR POLLUTION, IN ONTARIO.

Mr. A. H. Cowling, Chairman,
Presiding.

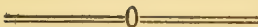
Dr. Frederick Evis, Secretary.



VOLUME VII

Friday, October 7th, 1955.

Los Angeles, California.



R. C. Sturgeon,
Official Reporter,
Parliament Buildings,
Toronto, Ontario.

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S E V E N T H D A Y

Los Angeles, California,
Friday, October 7th, 1955,
9:00 o'clock, a.m.

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The further proceedings of this Committee
reconvened pursuant to adjournment.

Mr. A. H. Cowling, Chairman,
Presiding.

PRESENT:

Messrs. Brandon, Q.C.,
Elliott,
Murdoch,
Gordon,
Thomas (Oshawa),

Dr. Frederick Evis, Secretary.

APPEARANCES:

Mr. Henry Meiners,	Manager, Los Angeles Refinery, Union Oil Company.
Mr. P. N. Fawcett,	Supervisor of Effluents, Union Oil Company.
Mr. F. Van Acker,	Superintendent of Catalytic Cracking, Union Oil Company.
Mr. E. R. Freiss,	Superintendent of Crude Distilling, Thermal Cracking, Union Oil Company.

Mr. L. F. Grandey,	Superintendent of Bulk Operations, Union Oil Company.
Mr. Lester Smith,	Superintendent of Personnel, Union Oil Company.
Mr. W. H. Fair,	Chief Engineer, Union Oil Company.
Mr. Wallace Linville,	Administrative Consultant, A.P.C.D.
Mr. W. M. Parmelee,	Engineer, A.P.C.D.
Mr. John Chipman,	Chemical Technician, A.P.C.D.
Mr. H. Belyea,	Ontario Department of Health.
Mr. Wm. J. Mellor,	Senior Information Assistant, Air Pollution Control District.

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AT THE REFINERY OF THE UNION OIL COMPANY,
LOS ANGELES, CALIFORNIA.

MR. MEINERS: As you gentlemen may have noticed, many of our plants are quite high. The top floor of one of the catalytic structures is 210 feet off the ground, and many of the others have the cat walks, and so on, so there is always a chance of wrenches, bolts, and so forth, dropping down, and we make it standard procedure to ask you to wear these crash helmets. As you notice, we are setting you a good

example.

I would like to welcome you all here. I will go over briefly the refinery, and "Bill" Fawcett will speak to you in the conference room about our activities, and then you will tour the refinery, and after that, we will have lunch.

I would like you to do us a favour, and if you see anything which leads you to the question as to why we do this, or why we do not do something else, we should like you to ask the questions, because you may see things that make you wonder about air pollution which we do not see, and your calling them to our attention will be useful.

On the other hand, we might explain our situation." So if you have any comments along those lines, we would appreciate it if you would make them at once, and you can help us in that way.

The refinery occupies 4,000 acres, and we have reached a capacity of about 11,000 per day of crew.

We produce motor fuels in this refinery. We do produce solvents, aviation gasoline, and some bunker fuel. We also produce ammonium sulphate, as a by-product of the operations. In general, I would say this is a fuel refinery.

In the processing operations, we have a large thermal cracker, probably one of the largest in the world. It is one of the last ones which was built. It was completed in about 1943.

We also have catalytic crackers, both of a thermofor type which use a pelleted catalyst, and conveyed around the system with elevator pockets, and also by fluidcatalyst, which is, in fact, blown around the system, using the processing gases.

We have a processing plant to produce aliphates, from the cracked butane. We have a summarization plant to produce the isobutane, which is needed for the alhalation reaction. We produce cleaning solvents, and we have the Edeleanu process, which uses liquid sulphur dioxide to extract the aromatic fractions from the oil, so the solvents themselves are more desirable.

We also produce from some of the extracts, aromatic solvents.

MR. BELYEA: Is there any benzol produced?

MR. MEINERS: No, we produce no benzol.

The aromatic solvents are produced from crude mixtures.

THE CHAIRMAN: Mr. Meiners, from hearing pollution experts with whom we have been associating all week, we are led to believe that the catalytic

method of refining gasoline causes more air pollution.

MR. MEINERS: I think some people will dispute that.

THE CHAIRMAN: Will you dispute it, as far as you are concerned?

MR. MEINERS: Oh, yes.

MR. BELYEA: Doctor Haagen-Smit disputed it last night, too.

MR. MEINERS: I think we are at the stage where nobody knows what it is.

THE CHAIRMAN: Why do you have the two forms, the thermal type and the catalytic?

MR. MEINERS: The thermal type is the method of cracking heavier oils to make gasoline. The heavier oils are heated to high temperatures, and they crack the motor gasoline and the fuel oils. That is a procedure which has been used in the industry since the early 1920's, up until about 1941 or so, when the catalytic cracking came in.

The catalytic cracker uses a clay type of material to aid the cracking. As a result of that, you do not need as high a temperature, nor as high pressure.

The gasoline produced by catalytic cracking has a higher octane quantity. And it is more efficient.

The first of our plants was built in 1944, that is the one which uses the pelleted type of catalyst. The second used the fluid catalyst and was put into operation in 1952.

THE CHAIRMAN: That is very interesting. In other words, as far as your oil Company is concerned, you are not concurring in any of the scientific studies which would indicate that the catalytic puts more pollution or poison into the air than the thermal type?

MR. MEINERS: That is right. And I say now, it is not possible to reach a final conclusion. Everything that is known about it has been corralled but that does not mean that someone will not discover something more.

We feel we are very clean as far as pollution is concerned. Certainly we let out odours occasionally, but that is separate from air pollution.

THE CHAIRMAN: I meant that as a general question; not your Company in particular, but in general.

MR. MEINERS: I keep a book containing all the things which interest me in that regard, and I understand that there is quite a controversy on that point.

There are working in this refinery, on an average of about 1,500 people.

THE CHAIRMAN: You are going twenty-four hours a day?

MR. MEINERS: Yes, and seven days a week, all the year around.

The larger catalytic plant shuts down generally once a year for two or three weeks for overhaul. An overhaul like that costs about a couple of hundred thousand dollars, so it is quite an undertaking. The thermal cracker comes down every three or four months for maintenance work.

THE CHAIRMAN: They need a little more servicing than the others?

MR. MEINERS: Yes. The physical condition with temperatures and pressures is a lot more severe. We know that something forms in the process, which lays down on the tubes, and has to be burned out. Some people would drill it out. That is let out of the catalyst and is returned to the catalyst in the regenerating section.

THE CHAIRMAN: Would you say that the catalytic method may be less expensive for your Company, but still produces as good a grade of gasoline?

MR. MEINERS: Yes.

MR. BELYEA: What is the maximum octane you can get with the catalytic?

MR. MEINERS: That is quite variable. With the full oil range gasoline, we occasionally produce from the plant a mixture of two gasolines, one a light gasoline, and one a heavy gasoline, which are later blended into the lighter motor fuel. With the light gasoline, which comprises about 80 percent. of the volume, the octane will be higher than 97. With certain changes in stock characteristics, they can get to 99.

MR. BELYEA: What do the high-compression cars require now?

MR. MEINERS: Our premium is higher than 96.

MR. BELYEA: The modern cars require that?

MR. MEINERS: Yes.

MR. BELYEA: Will they be wanting to go farther than that in the next few years?

MR. MEINERS: It is predicted that by 1960, it will be at 100, for premium gas.

MR. BELYEA: Can you tell us something about oil for truck Diesels and railroad Diesels? You produce oils for that use?

MR. MEINERS: Yes. For Diesel engines, we actually sell four different types of oil -- actually, it is five, of what you might say is the very top grade.

That is for General Motors Diesel engines, a type of engine very often used in buses -- and we have buses here -- the fuel is a highly-treated kerosene. It meets all the specifications for kerosene.

MR. BELYEA: Is that called "No.1"?

MR. MEINERS: We call it "kerosene". We re-brand it as "G.M.C. Fuel". We do not use the terminology of "1", "2", "3" and "4" very much in connection with this gas. It is used in the eastern part of the country, and I presume in Canada, but we do not use that terminology at all. It is "kerosene" and has a boiling point of about 520 degrees Fahrenheit.

MR. BELYEA: What about the road trucks?

MR. MEINERS: The regular Diesel fuel has a boiling point of 650 degrees Fahrenheit. It has variable sulphur contents of from .8 to 1.2, and is of good colour.

Then we are shipping to the railroads now what we call "locomotive Diesel fuel". It has a ^{higher} some-what/boiling point, and I suppose it might go as high as 750 degrees Fahrenheit. It is a mixture of straight run and catalytically cracked oils and its price is **lower** than the virgin Diesel. It gives the railroads a rich mixture gas, but they figure they are better off to spend the money on maintenance, than on fuel oil.

Then we also sell low viscosity residual fuels, which go for marine Diesel engines. There are two grades of that. They are essentially a bunker fuel which has been cut back to a low viscosity, and most of the railways say they prefer to spend more money on maintenance.

MR. BELYEA: Have you any idea of what is involved in that?

MR. MEINERS: No, I really cannot say. I think that it is probably cylinder wear, overhauling and cleaning the rings, bearing problems, and things of that sort. But I can only hazard a guess on that; I am not sure.

MR. BELYEA: From your standpoint, do you like to sell that oil to them, or would you prefer to sell the lighter oil?

MR. MEINERS: We prefer to crack the lighter oil ourselves and then sell them what is left over. Then we try to fix it up so we get a good enough price to make it worth while. But prices can shift on those things.

MR. BELYEA: In the east, in some places, we have trucks running on No. 1 and No. 2 oils; the No. 2 oil smokes pretty badly in the cities and some of the cities require that they use No. 1.

Is there available in this district, the two different fuels, so you have that problem?

MR. MEINERS: I do not believe the major problem is smoke. In this area, it is one of performance and engine loading. At least, that is my understanding, and that would be my impression.

MR. FAWCETT: Were you speaking about railroad Diesels?

MR. BELYEA: I was thinking of the truck Diesels. We saw one today, where the smoke was just shooting out.

MR. FAWCETT: There is the two-cycle and the four-cycle. There is a fundamental difference in the operation. I forget which is the worst, but one has more of a tendency to make this black smoke than the other.

I believe the G.M. Diesels are less likely to produce smoke, and that is the type most of the trucks and buses in this area use.

MR. ELLIOTT: Are there No. 1 and No. 2 types of fuel oil for Diesel engines?

MR. MEINERS: Yes, there are, but we do not call them that. The two types we have are, first, the General Motors Diesel type, which is the kerosene boiling range material. Then there is the normal

Diesel fuel. I am quite sure the specifications for that are quite common to the Pacific Coast. The viscosity is 41 seconds Seybott universal at 100 degrees Fahrenheit, and has a final boiling point of around 650 degrees. That is the Diesel fuel on the Pacific Coast.

There are a few who use the General Motors Diesel engines, which require this kerosene.

THE CHAIRMAN: Would you tell us a bit about your problem, if you have one, and particularly as to what steps you have taken to eliminate this pollution? Maybe you do not have a problem.

MR. MEINERS: Oh, we have our problem, I would say, rather definitely, and it starts away back when. We had mainly the odour problem in the first place. This goes back before air pollution, as such.

We have neighbors here whose properties are right against our fence line. In the years gone by, we gave these people hell -- no question about that. I have been happy in knowing that in the last two or three years, we have had only one complaint.

All through the years we have been tightening up, as far as releasing odours is concerned. Of course, there may be the miscellaneous upsets which occur almost any place.

However, the frequency is down. You gentlemen may smell odours today, but a little later on, you may not. I am used to them, but we have visitors who come here quite often, who are a little amazed that there are not more of them. We are quite overjoyed, because we are now "kicking" about the fish canneries in San Pedro, so we think we are "getting some place".

There are trucks which do stink considerably, and they do "get away with it" occasionally.

I feel that our neighbors on the fence line are one of the good indicators, because our advice to them is to complain, that is, if they have something to complain about, tell us right away, so we have a chance to track it down. It does not do much good to have somebody come in this morning and tell us what happened last night. It is a terrific problem to check back on what happened.

THE CHAIRMAN: You have to get it now?

MR. MEINERS: We can track back, but it becomes much more difficult. So we encourage them to complain, and we have not had any problem, so I think from an odour standpoint, we have gotten along quite well.

Most of you undoubtedly have quite a bit of

literature on the general problem in the Los Angeles Basin, and in the beginning there was some SO₂, and with our stacks we allowed .2 percent by volume of SO₂, which is the maximum, and our fuel was such that we did not have any legal problem on that basis.

We very early did put in sulphur, H₂S, and then took the H₂S out of the cracked gas, and took the sulphur from that, but I assure you that is not an economical operation. We did not make money on it. It did pay off from selling the sulphur, but it is the kind of operation we would never have touched, for economical reasons, at all.

MR. BRANDON, Q.C.: Do you find a market for all of the sulphur?

MR. MEINERS: Oh, yes.

MR. BRANDON, Q.C.: In connection with the matter of the different grades of Diesel oil; the second grade smokes more than in the higher grade in truck burning; is that it?

MR. MEINERS: You are getting me into an area now about which I do not know. We sell only one grade of Diesel. I would assume the heavier grade would smoke more, but I do not know.

MR. BRANDON, Q.C.: Are the fume-producing qualities of a Diesel engine, commensurate with the

blackness or density of smoke from the Diesel engines? In other words, do you get more potent fumes from second grade Diesel fuel oil than from first grade?

MR. MEINERS: I think you meant that the fellow who is running with a heavier Diesel fuel, might be causing more air pollution than one running with the top-grade fuel. It would depend on the quality of his engine, and how it was operated. That is probably more of a variable than the fuel itself.

MR. BRANDON, Q.C.: In the motor cars we are driving, we are accustomed to the poor, second-grade gasoline. Is there more likelihood of producing pollution, coming from that second grade, than from the top grade?

MR. MEINERS: No.

MR. BRANDON, Q.C.: Are they on a par?

MR. MEINERS: I would say they would have to be on a par, yes.

MR. BRANDON, Q.C.: Sometimes, with the lower grade, so to speak, we get quite a "pinging" in the automobile engine, which you do not get from the first grade.

MR. MEINERS: That "pinging" results as the pistons come up in the cylinder, and the spark fires into the cylinder, and the pressure gets into

the cylinder for that particular motor fuel, and it starts to burn too fast, and it is an explosion, rather than a burning. That is what causes the "pinging".

The "pinging" is like metal cracking. It is like hitting a piece of steel with a hammer. That is what "pinging" is. The "pinging" comes from the explosion or rapid detonation of the motor fuel, rather than from normal fast burning.

Do I make myself clear on that question?

MR. FAWCETT: The question was, why the second grade "pings" more than the first.

MR. MEINERS: It has a lower octane number, and that is why it "pings" more easily.

MR. BRANDON, Q.C.: Then the first grade actually "pings", but you do not hear it?

MR. MEINERS: No. The first grade of gasoline does not "ping".

MR. BRANDON, Q.C.: My experience has been with a standard grade of gasoline, with the second grade during a heavy pull, the engine tends to slow up, and when you get to running at 30 or 35 miles an hour, you do not get the "pinging" at all.

MR. MEINERS: That is right.

THE CHAIRMAN: Mr. Meiners, in connection with

air pollution; would you care to hazard a guess on how much money your Company has spent in eliminating air pollution -- both the odour and the other things -- in your section of the area?

MR. MEINERS: Leaving out the odour part -- because that has been done by spending money in a normal operational sense, that is, it has not been especially earmarked. But for air pollution, it gets into the actual programme of the district.

Since 1947, we have spent about \$8 million in this refinery. Of that \$8 million, somewhere in the vicinity of three-quarters of a million dollars has been spent by the Company on poisonous research work, standard research and others.

Some of the expenditure has been a straight, outright, pure expense, to eliminate air pollution.

Some of the expenditure, such as for sulphur removal, has been an authorized expenditure for air pollution, and there has been some cash return. It is not a net gain at all. In other words, we spent far more on these facilities to produce sulphur, but that is not all a net loss, because there is some gain there from it, being an operating expense, high as it might seem.

THE CHAIRMAN: Mr. Meiners, just following that:

in Ontario, our legislation gives to the municipality certain permissive legislation. We have no control over trains, ships, brick companies, and some steel plants, and so on. In other words, there are certain exemptions to the local by-laws.

You may not want to answer this question, but if you would care to, I would like you to.

We understand that in the state of California, they passed legislation which gave the Air Pollution Control District officer certain arbitrary powers, to dictate to industry and others, as far as this air-pollution set-up is concerned.

If the government had not given these powers of compulsion, shall we say, would your Company have spent \$8 million in your programme of reducing the contents, or even eliminating air pollution in the area?

MR. MEINERS: I think we would have spent about \$6 million. That "\$8 million" is a very approximate sort of thing, because let me emphasize that on these sulphur removal facilities, we do not have to have those, to comply with the law.

THE CHAIRMAN: That is the type of information we would like to have. In other words, as far as possible, you are going ahead on this programme and

co-operating with as little compulsion as possible in this district?

MR. MEINERS: That is true, definitely. I think we might put our position this way; we have to live in the community, just like we have to live with our neighbors. We are all human, and we may do certain things which are not exactly required, but we do them. We keep our gardens and our lawns neat, because that is the thing to do, and it does pay off.

Let me give you one more example, in answering your question about the money we have spent.

We have put floating roofs on a tremendous number of tanks -- I guess around 120 of them. Many of these floating roofs are not required by a strict interpretation of the law, but we feel that floating roofs are very nice things to have, from a fire-hazard standpoint, and I am sure that within a period of some years from now, we probably would have had them on anyway.

So if we take the \$8 million in the first place, and say how much was legally required, it would pose almost an impossible question. It just could not be determined.

I do feel that at least \$6 million of that money would have been spent by now, and, of course,

the three-quarters of a million dollars was spent for research work, to find out "what goes".

We are busy now in getting rid of a number of steam plumes in the refinery. If you look out of the window, you will see these little wisps of steam coming out. We feel we have to get rid of them.

It may sound a little ridiculous, but after having been through this business over the years, if you read the newspapers, and take a look at the "pastings" the oil refineries have taken in regard to this situation, we have to look like almost as if we were shut down.

MR. THOMAS (Oshawa): You mentioned the floating roofs assisted in lessening the evaporation?

MR. MEINERS: Yes.

MR. THOMAS (Oshawa): Do they lessen the fire hazard?

MR. MEINERS: Yes.

MR. THOMAS (Oshawa): I can understand that, Mr. Meiners.

MR. MEINERS: In a normal tank, with a cone roof, there can be explosive mixtures, which can become ignited, and when they start to burn there is danger of the oil exploding. It is almost impossible to put out a tank fire. They just have to burn out.

MR. THOMAS (Oshawa): And these roofs would

have a smothering effect?

MR. MEINERS: Yes, definitely, because it floats right on the oil.

THE CHAIRMAN: I do not suppose there are any other companies from other parts of this district which have spent the money you have on controls? Is that a fair assumption?

MR. MEINERS: You are speaking about oil refineries?

THE CHAIRMAN: Yes.

MR. MEINERS: The bulk of the work by industry has been done by the oil refineries, so far.

THE CHAIRMAN: Would you say that, Mr. Mellor?

MR. MELLOR: Yes,,I agree with that. In this area, there are four major refineries, and they just stick out like a sore thumb. When a programme like this comes around, we always have to find a scapegoat, and, in this case, it is the oil industry.

THE CHAIRMAN: Well, you make all the money ,and you are the "scapegoat".

MR. MEINERS: It shows up in the higher prices of gasoline, but I do not think the people object to that, because the smog situation is a bad situation; no doubt about that.

MR. BRANDON, Q.C.: Do you engage a staff of researchers of your own, or are researchers engaged?

MR. MEINERS: We have people in our own Research Department who work on the problem, but it is mostly a co-operative activity. We do get a number of technical and scientific reports in the refinery, to see if they have something which would be of importance to us. But most of the research work is done in their laboratories. The Stanford Institute has been doing most of it.

THE CHAIRMAN: We understand the automobile manufacturers are now conducting research to eliminate the oxide fumes. Would you have any idea on that -- some little gadget, which may cost about \$25.00, which you can hook on to your carburetor, or some other part of your car, and eliminate the gas fumes.

MR. MEINERS: All I know is what I read in the paper. It is certainly an unsolved problem.

I know if one walks into a garage anywhere, he can smell it, and feel it in his eyes. That is something to which I am not very close.

THE CHAIRMAN: And you would not be too much interested anyway; you are still manufacturing gasoline, and it is up to the automobile manufacturers to do a job there?

MR. MEINERS: Yes.

THE CHAIRMAN: That is, the automobile manufacturers?

MR. MEINERS: Yes. I think the whole programme is one in which the oil industry can become active very easily, because we were in a position of having a finger pointed at us, and we wanted to assure ourselves as to whether we were or were not contributing, so we did go into it quite heavily, and I think, in general, our relations with the District and others have been quite good. There has been a very co-operative attitude.

We have got into some arguments. We have a court suit going now, because we think the decision of the District Officers was unfair. We are now appealing the case. These things come up any time; it is a matter of opinion.

We feel -- and I am pretty sure the District feels -- that in our relationships, we are working toward a common problem, and have to solve it.

THE CHAIRMAN: You think the District Air Pollution organization -- that the powers they have are too broad? We understand they are pretty broad.

MR. MEINERS: That is a very difficult question to answer. Let me answer it this way,

by pointing out that many people think that in my function as refinery manager, I can conduct the affairs of the refinery, regardless of anyone's opinion. You gentlemen are all aware of the fact that this cannot be done.

I do have power, and I do have authority, without which it might make it difficult for me to run the refinery.

I think this thing is apparent, that the authority and power are necessarily a necessary requirement, and they are helpful, but you do not solve the problem by a show of force.

THE CHAIRMAN: In other words, when co-operation and education fail, then, as a last resort, you can always put the finger on it, and say, "This is it"?

MR. MEINERS: That has happened, but it has not been found very successful. However, the potentiality of being able to say "Do this" or "Do that", is a great step in the right direction. It gets into a situation, such as when this country tried prohibition. It did not work. This is the same type of thing.

If you try to solve the problem by legislation and a show of force and power, and so on -- well, you

cannot do it.

THE CHAIRMAN: Our people are not built that way. We do not like to be told too much that we have to do things.

MR. MEINERS: That is right.

THE CHAIRMAN: That is very interesting. Is this about all the time you have, Mr. Meiners?

MR. MEINERS: I have as much time as you gentlemen require.

I think perhaps Mr. Fawcett will go over some of the things rather briefly, and then if you would like to look at the refinery, you can do so, and we can talk about it further at lunch time.

I have all the time that would be useful. The gentlemen who will be guiding you are our top operating personnel, and are responsible for the operation, employment and so on.

--Whereupon Mr. Meiners retired.

---The further proceedings of this Committee adjourned to the Conference Room of the Union Oil Company, Los Angeles, California, and proceeded as follows:

P. N. F A W C E T T,

Supervisor of Effluents, Union Oil Company, appearing before the Committee, but not being sworn, deposes and says:

BY THE CHAIRMAN:

Q. Mr. Fawcett, would you tell us just briefly how you dispose of your effluent?

A. Well, in order for the rubber industry to use it, it has to be purified. Now, to pay for the cost of operating, you have to sell your product at a higher price. We do not have a purchaser for that kind of material, and we do not have that kind of equipment, so we just burn it.

---Further discussion regarding the uses of rubber, not reported, by direction of the Chairman.

BY MR. BRANDON, Q.C.:

Q. How does it come about that the heavier dioxides are removed earlier?

A. I think, as Mr. Meiners said, when the air pollution problem started to develop in Los Angeles, it was during the war years.

After the war, it was obvious there had to be some steps taken to combat it, and the oil industry -- first of all, the Air Pollution Control District was formed in 1946 or 1947; something like that -- and their approach to this problem was to review the literature, to see what had caused serious air-pollution mishaps throughout the world in the past, and very frequently some of these incidents have been due to

SO₂, that is, the SO₂ was present when some of the serious problems occurred in various parts of the world.

So an investigation was made to endeavour to ascertain how much SO₂ was produced in Los Angeles, and it was found that 500 tons or 600 tons was being produced per day.

Q. Has it been established that the sulphur dioxide is the cause of smog in this country?

A. No.

Q. Was that followed up without too much research?

A. The theory was that the equipment to recover the H₂S to prevent the SO₂, was connected with a story as to what it was caused by, and, as Mr. Meiners said, there was a certain expenditure made, and it was decided that SO₂ does contribute to the crop damage, and the eye irritation.

Q. Your present-day research has shown that sulphur dioxide is not a contributor to the smog conditions here?

A. I will not say it is not a contributor, but, the general approach was that any emissions into the atmosphere could contribute to the smog conditions.

Q. But it was not the causa causans?

A. It was not solved how the problem got worse, and we started looking for other properties, and we came up with the hydrocarbons, which led us to automobile exhausts, so now it is advocated that the oil industry is not nearly as bad as it was painted ten years ago, and it has increased public activity.

Q. Have there been any studies made as to whether it would improve conditions to leave the sulphur dioxide condition in the air?

A. I have heard that thought expressed. I do not think there has been any study made along that line as yet.

I would like at this time to introduce some of our people. Mr. Van Acker, who is the Superintendent of our Department of Catalytic Cracking, Mr. E. R. Freiss, Superintendent of the Thermal Cracking Department, and Mr. L. F. Grandey, Superintendent of Bulk Operations. Mr. Freiss is also Superintendent of the Crude Distilling. These gentlemen are concerned with gasoline production, and, within certain limits, the blending of them into the finished products, so they can be sold on the market.

If it is agreeable to you gentlemen now, we will make a tour of the plant.

---Whereupon an inspection was made of the Union Oil Company refinery at Los Angeles, and upon returning:

MR. MEINERS: Gentlemen, are there any other questions we can answer for you?

THE CHAIRMAN: I think you have pretty well answered all the questions, Mr. Meiners. I can assure you if this group had any more, they would certainly ask them.

MR. MEINERS: I appreciate very much having you with us.

---Whereupon the Committee was entertained at luncheon by the Union Oil Company. And upon resuming:

MR. MEINERS: It was a great pleasure to have you with us today, and we hope you enjoyed your trip.

THE CHAIRMAN: We did enjoy it very much. And I would like, on behalf of our little group, to thank you sincerely for your kind hospitality here today.

For the benefit of some of the others who were not present this morning, may I say that we are a Select Committee of the Ontario Legislature, set up to study and report on Smoke Control and Air Pollution, to the ultimate benefit of the citizens of Ontario.

We decided to come to California, because we heard you were very progressive here in this particular matter of control, and having spent time since last Tuesday here, we can see that a big job is being done, and certainly there are many things we can take back to our people, which will be most helpful and instructive.

This is an all-Party Committee of the Legislature. In Ontario, we have three Parties represented, and each Party is represented on this Committee. The members are all elected representatives, and are re-elected, we hope, about once every four years.

If you would permit me, I would like to introduce them to you this morning.

Mr. Thomas, representing one of the Ontario ridings, of Oshawa.

Mr. Harry Belyea, our engineer and technical advisor on the trip.

Doctor Fred Evis, the Executive Assistant to the Honourable Minister of Health of the province of Ontario. I may say he is a Medical Doctor and also a lawyer, and is functioning as Secretary of our Committee.

Then we have Mr. Elmer Brandon, Q.C. -- in Canada, that means "Queen's Counsel", learned in the law.

Mr. George Gordon, from the constituency of Brantford. As a matter of fact, Mr. Gordon and Mr. Thomas are the two Opposition members on the Committee.

Then Mr. Elliott, the member of the Ontario Legislature for one of the ridings of the city of Hamilton, which is one of the thriving cities of Ontario, with a population of about 225,000. In that riding is located a large steel industry.

Then the Whip of our Party -- I do not know whether you call them "Whips" here or not -- but he keeps the rest of us in line, and we are pleased to have our Party Whip with us as a member of the Committee, Mr. William Murdoch. Incidentally, he took off just recently to get some firsthand information about Mexico, and we hope he will be able to give the Committee the result of some of his experiences.

And I think you all know Mr. William Mellor, the Public Relations Chief for the District.

MR. MELLOR: I am the head of the Information and Education Division.

THE CHAIRMAN: Then we have our two very faithful and capable drivers, who have been taking us around all week.

I would like to call upon Mr. George Gordon to extend our thanks on behalf of the Committee.

MR. GORDON: Mr. Meiners, Mr. Chairman and gentlemen. In conversing with our friends here, I find they are not very conversant with where we live in Ontario. I am always very proud to speak about Brantford. I suppose none of our American friends have heard about Brantford, but it is a city of about 50,000 population, located about 75 miles from Niagara Falls.

Brantford has the distinction of being the city where the telephone was invented. I am always proud to tell our friends that. That is the city where it was invented by Alexander Graham Bell, and where the first telephone communication was made.

Mr. Chairman and gentlemen, I am happy to extend on behalf of all the members of the Committee, our sincere thanks for the way we have been received today, for the information we have been given, and the assistance afforded to us. You have certainly treated us very royally here, and we appreciate it very much, and we will think of our visit here when we get home as one of the highlights of our trip, and when we hear someone speak about seeing an oil refinery in action, we will know what they are talking about.

We appreciate again, all your courtesies, and we thank you sincerely.

MR. MEINERS: Thank you very much, Mr. Chairman and gentlemen.

MR. MELLOR: If I may be permitted to make just a few remarks. Having been a teacher for many, many years, I never pass up an opportunity to speak. In fact, I started out as the Superintendent of Schools when I was twenty years of age. For thirty-five years I was a Superintendent of Schools, and then I became the Dean of Men at the University of Oklahoma, and spent nine years in that capacity.

I want to say to Mr. Meiners and his group that on behalf of the District and my colleagues, we appreciate the hospitality which has been extended to this very fine group of men from Canada. I know that I myself know more about what is happening at the refinery level now than before I came here today.

I have visited some of the neighbouring refineries, such as the Standard at Elciado, but this is my first visit to your refinery.

Many, many times we are called upon to answer questions concerning refineries. I made the statement to Mr. Meiners, and some of the members of this august group, that since January 1st, I have made ninety-three public appearances myself. From January 1st to August 31st, the speakers of whom I have charge,

have made 256 appearances before some 16,000 people in the County.

I do feel that meetings like this are very important. More of our people should come out to see what you are doing, and I do want to thank you, Mr. Meiners, and especially your corps of guides, and Mr. Fawcett, for giving us a most enjoyable and informative tour.

I am particularly interested in what you are doing and when I go back, and hear people say, "Why do you not close down the refineries?", I will be in a better position to properly answer questions like that.

I thank you very much.

---The Committee adjourned from the luncheon at 1:25 p.m., and reconvened at 2:00 o'clock, at the Santa Fe Laboratory, Los Angeles, California, where an inspection was made, and the following equipment was shown and demonstrated to the members of the Committee:

1. Ultra violet Spectrometer to measure ozone.
2. Ozone generating machine made at the laboratory.
3. Nitrogen oxide 8 bottle rotating automatic sampler. (1 bottle per hour).
4. Demonstration of ozone titration with 2% potassium iodide solution. Making a set of colour standards using KI solutions and varying concentrations of ozone. This is the titration used when deciding if a "Smog Alert" is to be announced.

5. Absorption Spectrometer for detecting hydrocarbons in the atmosphere.
6. Thomas SO₂ Autometer.
7. Beckman Infrared Spectrophotometer.

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---Whereupon the Committee went to the Automotive Laboratory, Los Angeles, California, where the following proceedings were had:

MR. LINVILLE: In doing this type of automotive test, we chose a Chevrolet car, because basically there are more Chevrolets than any other engines.

This (indicating) is our testing engine, chosen because the manifold is exposed. The old V-8 straight manifold was built into the engine, so this one (indicating) is easy to have changes made in it.

This (indicating) is the power-absorbing mechanism, and consists of a series of flapper blades which go through water, and if you let in more water, you are putting more load on the engine.

As perhaps you know, the most of the damage is in deceleration, so a great deal of work is done with deceleration. About 60 percent. of the emissions from a car, come through deceleration. We do put some additional power, to put this engine in the

position of pulling down hill. By pulling this bar (indicating), we can put this in high gear, and we are able to produce a decelerating condition here (indicating). Again, if we do want to take some examples from this engine (indicating), we can use this one (indicating) to push the other, so we have a drive from one to the other.

Last month, we had a bus engine -- a large Mack engine, -- four times the size of this (indicating), and we had enough power to carry the engine down hill with this (indicating) alone.

DOCTOR EVIS (Secretary): Would you mention the four phases, and the percentage loss of each phase?

MR. LINVILLE: Idling gives us about 8 percent. Our total hydrocarbon emissions from automotive engines at cruising is about 17 percent., on acceleration about 19 percent., and on deceleration, about 64 percent.

To get the figures, there are two things which have been taken into account. To begin with, idling -- in parts per million -- you get about 1,000, 1,100 or 1,200, while with cruising on deceleration you get only 250.

On idling, the exhaust volume is so low that it does not affect it so much as in the other case, where the volume may be greater. So most of our

time is spent in taking that into account.

In Los Angeles, we get about 18 percent. driving, 18 percent. acceleration, and 18 percent. deceleration, and 46 percent. with cruising.

So our total hydrocarbon reflects the time spent in the various cycles. So you can see why deceleration is the most potent.

At times, some person will come in and say, "I have a device to make this hydrocarbon less". At most, we are only using 8 percent., so if they can help us out by even 50 percent., it would only amount to about 4 percent. which is not very great.

So we are now working on a device which will shut off on deceleration, and which we hope will save at least 50 percent. of the total hydrocarbon recovery, and that is why we are spending so much of our time on the idling, and if it will give us about 50 percent. removal, then we can look forward to having accomplished something. We are looking for a burner which will take up material on the other cycles, where they will get into the range of at least 90 percent. efficiency.

This valve (indicating) we have on now was just put on by an interesting -- we will call him a "character" -- because he is just that -- he has had

this so long, the patent has expired. They used it on these double deck buses which ran down Wilshire Boulevard, and it discharges the hydrocarbon which you do not smell when it comes out of the machine.

This (indicating) is an interesting application. One of these scavengers air into the engine, and also eliminates some hydrocarbon, but in order to value this we have to compute the air pollution, because if we take samples to see how much more we can dilute the samples down, we have not helped the situation.

So we have to take into account the dilution factor, so we have to measure our air both in the engine and the device, which takes in air.

So we put orifices into the drum, and we can ascertain exactly what fractional part of air that is being utilized.

This (indicating) is the little scavenger and then we take a rubber cork, and stick it in the smaller end, so we do not have to hold it up to get a correct reading. We measure the air going into the engine, and also the fuel. We can put a watch on it, and weigh out a certain amount of air.

We have our air and fuel ratio going in and going out, and I think in the balance, it is going

out. This has been useful to us in connection with our readings, where before we had to check the accuracy of doing all these things. By the use of these things, we can make our work that much more accurate.

We have the vacuum and the speed and horsepower output of the engine, and these are all analyzed. We only use it as a control over the engine, so we will know that nothing has happened to the carburetor which will change the readings, and for that we use an electric tachometer, so we can pick the spots out.

If you like, I will give you a demonstration of just what I mean.

---Mr. Linville demonstrated the machine to the Committee.

MR.LINVILLE: Actually, what we did was to go up to the top of the hill and go back down again. We used this one (indicating) to push our Chevrolet engine.

You may have noticed when we were taking a little power, we got globy gases.

We are trying to establish these things and accomplish them in the laboratory, because it saves us the time of taking them to the other laboratory, although the hydrocarbons are tested in the laboratory

you have just left.

MR. CHIPMAN: I imagine most of these people do not know the background. Chemical-wise, there is a simple reason for keeping the gases to determine the efficiency of the internal-combustion engines of this type, and, of course, actually what we have here is a solution for getting carbon dioxide and oxygen and carbon monoxide, by passing through a series in various solutions.

It is very essential we have these values, because many times in addition to the hydrocarbon values, we have to make corresponding values, especially if we have a combustion device, and especially if we have a co-efficient to determine the efficiency of the combustion device. By this means, we can get the amount of air introduced by internal means, where it is almost impossible to measure it directly.

Then this (indicating) is another means of determining the efficiency of the engine, and that is, to determine how much solution of air is required to get good combustion.

This (indicating) is a modified apparatus for gas analyses. We do not have the personnel to do this at the moment, but it is going one step further, in the fact that we have two catalytic burners,

one for burning hydrogen and the other for burning up the hydrocarbons, that is, the quantities of hydrocarbons emitted from an engine, but the only time you get enough to measure is through deceleration.

There is a considerable amount of hydrogen from a combustion engine, in various ratios, and it is beneficial to know the amount of hydrogen you get, because in all these, you get a certain amount of hydrogen, and if you want to calculate the amount of water you produce by the combustion, you would have this figure, within 5 percent. We like to have them as close as possible.

Fortunately, all these compounds are those which we can analyze by this means, and we are not concerned now from an air-pollution point of view. This is to help us evaluate the constituents in which we are interested. If we know about 99 percent., then the other 1 percent. is what will give us the trouble.

This is simply for control purposes, and to give us an indication as to the general combustion, and also give us the amount of air through the various devices.

Where we can measure directly, such as Mr. Linville showed you, we like to use a system of one kind or another, to get it directly. We do not

have the instruments to measure the smaller quantities.

You are here several months too soon, but we have in the wind, data on an instrument for automatically recording the hydrocarbon directly from the exhaust, which will give us the answer immediately.

You people may be interested in how we check our samples. I think the method is simple, as it appears today. However, in order to arrive at this simple method, it required several years of work.

I will be happy to show you how we took the samples.

MR. LINVILLE: And I will show a few devices which are potential control devices.

In deceleration, you do not need the power from your engine, so you might as well shut off your fuel flow. Here (indicating) is the idling shut-off, and when the solenoid is weighed, a little needle comes down and shuts the flow off entirely.

This device will save you about 3 percent. of your fuel bill during the year and will materially lower the hydrocarbon emissions during deceleration.

That is the general device upon which the people in Detroit are working. It has been tested and is proving itself very well, but it does not

entirely stop this flow.

This next (indicating) is a vacuum-breaker type. The solenoid is energized, and you let in air through a huge carburetor, and as the suction is low, you no longer pull any gases out. You also get so much air in the system, that you do not dilute any of the odourous elements.

This is not a very major problem, but these devices, as you can see from these examples, are difficult to instal, and require such a manufacturing cost in order to obtain the control that we feel that the idling device might carry more weight than a more elaborate system.

This (indicating) is a vacuum-limiting device. It fits onto the manifold, and where the burning does not go through the various points, it draws in air. This shuts off the mixture from the carburetor, and allows air to come in. But if you put the full section on the engine, it actually bends the little valve, so we will have to send it back and tell him that while the principle looks good, he has to prove the device before we can make a satisfactory test.

These (indicating) are vacuum-limiting devices. Here (indicating) is another you will notice,

where the air scavenging in.

This (indicating) is a device which will increase the amount of hydrocarbon coming out of the tail pipe. This, of course, increases our problem. It will take the odour out, because you are bringing in enough air to have hydrocarbon removal, when you dilute the mixture down so it will not burn, but you catch more hydrocarbon than you did before. At first, we could not quite understand this, but now they all come in definite patterns.

This (indicating) was developed by a young fellow in our District. He took this (indicating) and energized it with a high frequency current, and vapourized it with supersonic speeds, and the mixture which is not vapourized hits this plate (indicating) and is drawn into the cylinders, and we were able to bring the engine with the manifold on it, down to idling, and so we think this is a principle which is worthy of further consideration.

Now, we wanted to see what would happen, so we got a block of lucite, and we will build it onto the engine, and then we can see the vapours going through and see what happens to our plate, and it will give us a little better idea of what is going on in the manifold. Again, we cannot compete

with the manufacturers in the east, but we will try it on one, to prove a principle which may be effective in telling us what we want to do.

This (indicating) is something which we do not think will help us any, because when we dilute it down, it no longer burns.

Many inventors -- very capable fellows in the field -- when they get into this field, the problem is so different that, unless they take the trouble to understand our problems, they will only give us something which is worthless to us.

Here (indicating) is another phase of our work. We need to know, when driving our cars, just how much percentage of less there is in when you are accelerating, decelerating and cruising. We know there are test teams which have gone out, but that is only one type of driver, so we have to get the average much more accurately. Our cars are directly-connected cars, and not equipped with automatic transmissions, because that type of car will not push your engine, as it would if it was directly connected with the mesh transmission, as we had a few years ago. So we have adopted the use of a mercury "U" gauge, and by inserting this (indicating) in this mercury "U" column, we can measure

the time, because, with the mercury, it will break the connection here (indicating), and when it goes up, it will make another connection here (indicating), and it will energize the solenoid, and we can go out and drive on a thirty-nine mile road -- which is the average for Los Angeles County -- and with a stopwatch we can tell how much time was spent in cruising, idling, acceleration and deceleration, and then we have a close check on some or any of these things. While it is crude the way it is, we hope to have it fitted, and to come up with an average, which will mean more than our figures do at the present time. As I say, we are sending our man out with a stopwatch. You would not know it was in the car, but when the man comes back we will know the details of his driving, and it will assist us in arriving at a reasonably accurate average.

MR. CHIPMAN: All our calculations were based on the driving conditions here in Los Angeles and our figures are no better than than what we base our calculations on. So we think that type of work is very important. When you get down to the drivers, we are concerned with them all in making our calculations. First, we have to get the values from the car, and then utilize the other types of information we get.

You can probably think of ten other variables. They are all being considered, because if we do not examine them, they call them to our attention. However, we expect that, and we had to start somewhere, to let everybody shoot at it.

It is very simple to take these samples. This (indicating) is the flask for taking hydrocarbon samples, and also our gas samples from a bus, for instance.

We calculate them down to a fraction, on an anemometer, and, of course, we take the samples to the other laboratory.

Did you ever see the infrared machine?

MR. MELLOR: I was not there.

MR. CHIPMAN: There (indicating) we have the machine. These are all calibrated, through the pressure in them. Then they go through the U.S.A. hydro counts.

When taking a sample, you can see what a great deal of help it would be to pass the gas, and have that record as fast as we can pass the gas to it. What we have done there is with a certain type of infrared.

The samples actually have mostly hydrocarbon, and we take out samples for engine efficiency, then we

take samples for nitrogen oxide, and we take samples for the aldehydes.

The two which at the moment seem to be the most important are the nitrogen oxide and the hydrocarbons. There is a grade of high ozone concentration, but cutting it back, it gives the hydrocarbons.

These (indicating) show the technicians' cycles. So, actually, it is not so simple a procedure.

Not only can we have them on these statistical test conditions, but it gives us the advantage, and we can also take the samples under these lower conditions. We can take the samples to any extent we want.

We put a retractor here (indicating), which requires about ten seconds to fill this flask, and when idling, you get a little scrub here (indicating) so in evaluating an engine's performance over a ten-second period, it tends to give us a fairly uniform grade.

Likewise, when we sampled some of the other gases, we took as long as thirty-second samples, and we find we can duplicate our samples very accurately, and get very reliable results.

MR. LINVILLE: On the road, where you have to take the samples without the restrictor, we took

three samples, for the purpose of getting a good reproducible sample, while in the laboratory we can only take one sample, and it will be reproduced. It saves time, and the number of samples.

MR. CHIPMAN: You have no doubt seen a number of these scrubbing solutions. We get a number of calls from people for solutions, and all you have to do is pass the oxides through the solution and that is it.

The hydrocarbons will change composition, and nothing will happen. Now we test some of them, and perhaps some of them are not effective, with regard to the time available to that. So, rather than pass the gas, we use the solution, and we put samples before the bubblers, and after the bubblers, we find we have a different bubble altogether.

We take samples of any reliable concentration upon which we can depend. So we get out, wherever we can, our extracts here (indicating), but we have to run samples for a long period of time. It is quite technical in that regard. Actually, it only needs a couple of seconds to take a sample, and from six to ten minutes to run the sample, and we can have the answers in about twenty minutes.

MR. LINVILLE: Originally, when we were

setting up, the new building was scheduled to be built within a reasonable time. Now we are here, and planning for the new building, and we expect to have it by fall, and it will be a more permanent set-up, and if we had not been angling for a permanent set-up, we would have been angling for another room.

Regardless of that, there is a great deal of work we can put out from this set-up, but we have not reached perfection as yet, by any means.

The idling shut-off is a mechanical device which probably has more chance to do something for us than any other, with a maximum of 50 percent.

We ran into another problem along that line. The flow of mixture here (indicating) we are not reducing our hydrocarbons down to zero, so we put in our valve to reduce it down to about 500 parts per million.

That means that we are probably cracking down the oil, which is analyzed as hexane, so that is the lowest one we will ever get.

If we put the carburetor back on, we find that with the idling shut off completely, we come up to 2000 parts per million.

We feel as the heat rises in the carburetor, it was vented to the outside atmosphere, and we will fit

up one of them back up into the engine here (indicating).

The Ford Motor Car Company showed 1000 parts per million, so it is possible when that device (indicating) goes on, we will have an odour in the carburetor and so it is vented. We may have to set it lower, so it will not slap out into the main jet. We think this will be developed now as a definite device.

MR. BELYEA: What is the over-all range reduction?

MR. LINVILLE: I wish I could answer that.

MR. BELYEA: General Motors indicated last year they were getting 75 percent.

MR. LINVILLE: With the idling shut off, it is impossible. I think what they may have meant, if they were talking about idling shut-off, was that they got 75 percent. of the deceleration cycle, and I think there are others who have done some work on this, and they have used the dash pot.

50 percent. is the best any device can do, which functions only on the deceleration cycle.

To get below that, we will have to get a catalytic cycle for a few burners which will give us the average result.

The engines are extremely lean, and the results

were somewhat confusing, when you go through the whole report. We checked every engine which the Los Angeles Transit Line use, and they were the leanest we have worked on.

The bus device was the better, in regard to the after burners, because when you start out with a bus, you open it wide and then you decelerate it at the next corner to make a stop, and you take out of that engine practically its full horsepower, every time you start and stop. So you can drive all day, and only use about 40 horsepower out of 250.

Catalytically, you can do that, and those are the tests about which you may have read, where the Hoodoo muffler failed, in San Antonio. It was a mechanical failure. With the catalyst floating around, these little particles of lead, were knocked off the catalyst.

We, in the laboratory, have been doing a great deal of talking about this, but I think it is something like treatment for certain ailments, where people will not go quickly for a doctor, if it is too expensive, but would, if it could be considered, price-wise, as a stop-gap measure.

People will use this if it is a \$5.00 stop-gap; if it is \$25.00, people would want to put on the

cheaper one as a stop-gap.

For \$5.00 we could tell them to put it on and get their money back the end of the year. If it was \$25.00, it might be a little more difficult. But the idling shut-off would help later on in the functioning of the catalytic unit. So it is possible that it might be used as a stop-gap measure, to reduce our hydrocarbon 50 percent, even though it would not clean up the whole atmosphere. It might help us today, for a few years, until the catalytic burners, which would help a great deal. The muffler we had was up near the headlights, but if you put it under the floor board, and you had your foot on the floor board, you would have to raise it, so there is some thinking about putting it between the radiator core, and the front of the car. You cannot adopt that for the two and one-half million cars in this County, particularly on those which may not be worth the price of the muffler. So we will have to go on with the new cars, which will probably take about ten years to complete. This may be the stop-gap.

This (indicating) has no advantage, that is, the catalytic sample has no advantage to the performance of your car at all, so you will never buy it, unless you are interested in the saving of gas, and

I do not think you are or you would buy a motorcycle or a Crossley instead of a Cadillac.

People will have to be forced to put them on, and it is questionable whether \$5.00 -- about 50 percent. of the owners do not know what is involved, so you see what the problem will be to get on, when we find a device, because, frankly, we have not found the device as yet, but we do have to have some pattern to go by.

The automobile industry is working on this problem, and I think they are doing a good job. If you could see our set-up as compared with theirs; we laughingly refer to this as our "Tom Thumb Laboratory". We cannot compete, but we can stimulate what they are doing. We have tested more devices than ever, and we have tested devices they have never had on their dynamometers, and we might come up with a gadget, we can sell cheaper than they can. Los Angeles is the most fertile place for inventors. Somebody with long, bushy hair, who cannot read nor write will come in, but we are pretty well "up" on what they are doing.

Some have good engines. There is an idling device shut-off handled by an engineering concern. It would not be as large as a thumb nail, yet by unscrewing

this little thing here (indicating) and screwing the other into it, it will do a good job.

I do believe we are getting closer. These fellows have no means of testing, because there is no other dynamometer set-up in all California, which has been erected for pushing an engine downhill.

So they have helped us, and we have come to know the status the State Department is in. If we had a device now which proved out here (indicating) we might get fifty of them out of the production assembly line, because a new model might work fine, but when you produced it for ordinary use, it is a "different kettle of fish" altogether.

We watched fifty of these in comparison with fifty normal cars which have that on, They say they are fine for the town buses, and we began analyzing them, to find out why. If these stay out, and others come in at a fast rate, we call for a road test.

We have tested them and know they are not giving as much trouble, but we know it is nothing more than a car device. I do not want anybody going around looking for my scalp, because we are putting out something which would not be efficient.

I think the average person would rather have an engine which would give a good performance, as

far as he is concerned, rather than all agreeing to put on a device, which perhaps would give them nothing but grief.

We think we are doing some good here.

Doctor Mader is studying the different types of hydrocarbon. You can have two engines, but when you put out the hydrocarbon into the atmosphere, it becomes more vicious, and produces smog. When you are idling, cruising or decelerating, you are getting it so hot that it makes it a little more difficult to study. On deceleration, the cylinders may be cool enough so that what you put in may be materially different from what you take out. Even though we are finding something rather interesting mechanically, we must overcome the fact that they have just shut it off.

As far as the L.P.G. and gasoline is concerned; that may be very material. Propane has so few carbon atoms in the molecules, that you generally crack down, and then build up, and as a result, the hydrocarbon from L.P.G. may be less offensive than from gasoline.

We have yet to see an L.P.G. engine that is not putting out more hydrocarbon than is put out from the old gasoline engine. The manufacturers are capable

of adjusting the lean mixture, but they are not able to hold the leanness. In none have we seen any advantage in the double hydrocarbon.

MR. ELLIOTT: What is the "L.P.G."?

MR. LINVILLE: That is "Liquid Petroleum Gas", that is, butanes and propane. There was some talk of doing it by solution, but we do not think it would be available in sufficient quantities. The fuel intake as it is today is no better, but it allows the elimination of the hot spot, and allows greater power. They will probably better them and improve them to where they will ultimately be a help to us.

Turbine engines would be a help, because when you are burning anything hot in the burning chamber you get better combustion.

MR. BELYEA: There are rumours that Detroit will have fuel injectors for 1957.

MR. LINVILLE: We had three men in here yesterday, and you ask them about it, and they will look at you as blankly as possible. We have been told they have a long way to go before fuel efficiency will equal the carburetion of a Cadillac carburetor.

We are not reaching for added power. The fuel injections for the road will cost many times what the others will. The injection system of a Diesel

engine costs more than the whole engine. I do not think you will see them in 1957. The industries say they will be lucky to see a device by 1958. The use of various fuels is not basically in our field. The industry is waking up to what is being lost, even though it is only 5 percent. or 6 percent. and it has been a real eye-opener to the industry itself, and I think they will find ways and means of improving this as we go along. Our problem now seems to be to get a good stop-gap, and get the industry to thinking.

MR. MELLOR: We will have to take off pretty soon. Let me thank you on behalf of this group, very sincerely, and that includes you, Mr. Linville, and the rest of your group.

THE CHAIRMAN: Mr. Linville, I would like to express our thanks for what you have said this afternoon. I think we have learned a great deal. I do not think we are ready for this at home, but we will be.

MR. LINVILLE: I imagine you will have a good many years to go, before it becomes a problem.

THE CHAIRMAN: Well, perhaps not so many.

MR. LINVILLE: Your reduction in visibility, does not necessarily come from smog, and your adverse problem is not there, and it will probably be eliminated

by adopting some of these things.

THE CHAIRMAN: It has been very nice to meet you and your associates here, and we can all see why they have been of such help.

--Whereupon the further proceedings of this Committee adjourned at 4:10 o'clock, p.m., to reconvene in the city of San Francisco, State of California, on Monday, October 10th, 1955.

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P R O C E E D I N G S

OF THE

SELECT COMMITTEE, APPOINTED BY THE ONTARIO
LEGISLATURE, TO ENQUIRE INTO CERTAIN MATTERS
AND LEGISLATION REGARDING SMOKE CONTROL AND
AIR POLLUTION, IN ONTARIO.

Mr. A. H. Cowling, Chairman,
Presiding.

Dr. Frederick Evis, Secretary.

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VOLUME VIII

Monday, October 10th, 1955.

San Francisco, California.

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R. C. Sturgeon,
Official Reporter,
Parliament Buildings,
Toronto, Ontario.

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E I G H T H D A Y

San Francisco, California,
Monday, October 10th, 1955,
9:30 o'clock, a.m.

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The further proceedings of this Committee
reconvened pursuant to adjournment.

Mr. A. H. Cowling, Chairman,
Presiding.

PRESENT:

Messrs. Murdoch,
Brandon, Q.C.,
Elliott,
Gordon,
Thomas (Oshawa)

Hon. Mr. Kelly,

Dr. Frederick Evis, Secretary.

APPEARANCES:

Mr. Frank M. Stead,	Chief, Division of Environmental Sanitation.
Dr. Lester Breslow,	Bureau Chief.
Mr. John Maga,	Chief, Bureau of Air Sanitation.
Mr. Norman Ayers,	Public Relations Officer, Department of Health, California.

Mr. B. D. Tebbens,,	Associate Professor of Industrial Hygiene, University of California.
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Mr. H. Belyea,	Inspector of Industrial Hygiene, Department of Health, Ontario.
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F R A N K M. S T E A D,

Chief, Division of Environmental Sanitation, State of California, appearing before the Committee, but not being sworn, deposes and says:

BY THE CHAIRMAN:

Q. You do not have anything here as they have in Los Angeles?

A. Those are challenging words. Nobody has anything just the same. We think we have a little of it, and we will show you some of our oxygen records, which is one measure, but not too precise a measure, of course, but we have run daily records five days a week in Berkeley and Pasadena, starting about two years ago, and we have a note where in the Bay areas we have 14 stations, as compared with 9 at Los Angeles, and as against the 9 under inspection, we have 6.

The responsibilities in our Department -- in case you are not familiar with them -- resulted from an Act of the Legislature last year, enacting a

Bill which we sponsored, which gives to this Department substantially the responsibility of studying and interpreting the phenomena of air pollution in the state, and re-affirmed the policy. In this state, the actual regulatory control is a responsibility of local agencies such as the Los Angeles Air Pollution Control District, and the newly-formed Air Pollution District in the Bay area, which covers six counties, and is under a Board of Supervisors, and all our 50 counties have their own control responsibilities.

With our own Department here, we are set up in six Divisions, and two major responsibilities for internal operation are preventative and medical services, a Division which Doctor Breslow heads, and a Division of Environmental Sanitation, which I head, and in which the Bureau of Sanitation lies.

So that the people from our own Department, whom you will meet today, Doctor Breslow, Mr. Maga, and Mr. Ayers -- who is our Public Information Officer, and is the one who has the connections with the Press --

BY MR. BELYEA:

Q. The two are under the Department of Health?

A. Yes. The Bureau which Doctor Maga heads is newly created, and has the responsibility of studying measurements, and so forth, and the Bureau

which Doctor Breslow heads will be operating more under the head of the medical surveillance, to find out the main facts in regard to air pollution.

BY MR. THOMAS (Oshawa):

Q. I believe the Air Pollution Commission in Los Angeles is financed mainly by industry. How does your industry here --

A. No, that is not quite correct. You are confusing the Foundation. The Air Pollution Foundation is an unofficial non-governmental agency which operates entirely on gifts and donations, but industry does enter the picture, to find out what is going on.

Your communication caught us a little -- not unprepared, but our schedule is pretty tight.

First of all, Doctor Merrill had a commitment in Los Angeles, which makes it impossible for him to be here.

Q. He is your Minister of Health?

A. He is called the "Director of Public Health". His is one of the eighteen or twenty Departments which operate directly under the Governor.

The Governor's office telephoned this morning, and the Governor advises that he received your letter too late to answer the communication, but has requested that whoever is your spokesman, talk

to the Executive Secretary of the Governor. He also is away from his office this morning.

We, ourselves, on behalf of this Department, are delighted to learn that you were interested enough to be here and visit us, and we want to make available as much time as is mutually desired, and this meeting is yours. Therefore, I think you might say what your schedule is, and I will ask you, Mr. Chairman, if you will move to the head of the table, and fire questions at any of us, rather than our giving you simply a canned and preserved lecture on research, which we have given before to some of our visitors.

I understand on Wednesday you are to see Doctor Tebbens?

BY THE CHAIRMAN:

Q. Actually, we have not "laid it on the line" as yet. Is Wednesday a holiday here?

A. It is a state holiday.

Q. Is your Department closed?

A. Our building is closed, but we can always get in.

Q. We are planning on leaving on Wednesday night for Chicago, and we thought that Wednesday would be a holiday for you here.

A. When I saw Doctor Tebbens last week, he said

he was contemplating spending some time with you on Wednesday.

MR. MAGA: It is not a holiday for the University, and Professor Tebbens has planned to spend Wednesday afternoon with you, together with someone from the Public Administration. Doctor May may be tied up, but Mr. Scott had planned tentatively to meet with you on Wednesday afternoon.

THE WITNESS: Have you an appointment with the Stanford Research Institute people?

DOCTOR EVIS (Secretary): We have not called them as yet. I wrote to them. We hope to get down there.

THE WITNESS: It is well to give them twelve hours' notice. We have a list of their people here, so I recommend this afternoon you place a call to them from here.

BY THE CHAIRMAN:

Q. I suppose it would almost take a whole day there?

A. Yes, because it takes a couple of hours to go down and a couple of hours to come back. They have quite an operation, and if you wanted to look around a bit, it would take some time.

Q. How is it related to the problem of air pollution?

A. For the last five or six years, the Stanford Institute contracted with the Western Oil and Gas Association, which is comprised of the eight major oil companies in the state, to carry on quite extensive research into the irritating agents of smog, as they might be connected primarily with the operations of the petroleum industry.

The results -- or a good deal of them -- are published in the report of the study, which was public, and some of the projects were unpublished reports to the clients.

This year, they are continuing under the sponsorship of the American Petroleum Institute, and are carrying on further research. So it has been a real attempt to unravel the riddle.

Q. Could we talk a little about legislation, and how it is going to affect us in Ontario?

A. Surely, we would be glad to do that.

---Chairman Cowling in the Chair.

BY THE CHAIRMAN:

Q. Let us "kick off" with this new legislation, and what powers it will give the municipalities to act on the question of smog control and air pollution. I think that would be a good place to begin.

A. . This is found in our Chapter 20 of Division 2 of the Health and Safety Code, which was passed in 1947. It sets up an air pollution district in every county, and provides machinery for its activation by a resolution of necessity by the Board.

One county for which it was primarily designed -- namely, Los Angeles County -- organized immediately and carried on a large scale programme. Two other counties acted in the next two years, one being Orange County, and the other was Santa Clara County.

In Santa Clara County, an officer was named as an "Air Pollution Officer", and he has, with a very modest budget, attempted to tie in a programme, usually as a consultation type of thing, to review all and every type of installation, considering the potentials and so forth, but never using the regulatory machinery of the law.

In Orange County, the job went first to the Building Department, and more recently to the Agricultural Commissioner, and it has been quite largely an information service, rather than a regulation.

It is recognized that it would never fit in to the San Francisco Bay area, where around the area, the shore line is made up of parts of nine counties, and it was found that this being the second

most critical area in the state, it was highly timely to get something underway, so a new piece of legislation creating specifically a district in six of these nine counties and providing for entry of the other three upon action by their Boards of Supervisors, was set up.

It took a great deal of unsnarling to get the data worked out, and the newest idea was that the Board was to be composed of one Supervisor and one city officer of each county, and all of the staffs in the county formed a selection committee to nominate a single city representative for that county. This will provide a Board of twelve men.

BY MR. THOMAS (Oshawa):

Q. How about the financing of the Board?

A. The financing is a carefully worked-out programme, which I think is primarily on a population basis.

MR. MAGA: On the assessed valuation and population.

DOCTOR BRESLOW: It is on local planning.

BY MR. MURDOCH:

Q. It is permissive legislation?

A. No, it is mandatory legislation.

Q. That a Board shall be set up?

A. Yes, and the date for this development was set as of the 20th of this month.

BY THE CHAIRMAN:

Q. So you have two districts?

A. No. It was on their own actions this year. The other air pollution legislation is permissive only; it is not mandatory, unless a finding is made that a critical conditions exists, and once it exists, the district is set up.

Q. And have you a number of control officers for the area?

A. No. Each county will name these two men on the 20th of this month.

Q. You are just getting into it?

A. Yes, and after the 20th of this month, probably early in November, they will establish the position of Executive Secretary or Control Officer.

Q. Do you feel that the conditions in the Bay area are comparable in perhaps a smaller way to what they are in Los Angeles?

A. Mr. Maga, do you want to chime in on that one?

MR. MAGA: The indications are that San Francisco Bay will experience more problems than smog. In the first week of this month, they had considerable eye

irritation in the San Francisco Bay area. The population is somewhat less than Los Angeles, and in using the accident measure to try and compare Los Angeles with San Francisco, San Francisco appeared to be about one-half or one-third of the way up the scale.

THE CHAIRMAN: Could you tell us what causes the eye irritation?

MR. MAGA: I cannot answer that simply. I do not know.

THE CHAIRMAN: You are not blaming anything in particular?

MR. MAGA: I do not think that anyone really knows.

THE WITNESS: I would say this from an engineering point of view. We are intensively seeking a rather broad measuring stick for air pollution, believing that our three metropolitan areas are similar enough so that the same yardstick can be applied, but we do not think the four, ozone, SO₂, and CO, and oxide of nitrogen in themselves, tell the story.

BY THE CHAIRMAN:

Q. What are your three metropolitan areas?

A. The San Francisco Bay area, the Los Angeles city and County area, and the San Diego city and surrounding environs.

MR. MAGA: Those represent about 65 percent. or 70 percent. of the state of California.

THE WITNESS: I think perhaps Doctor Breslow would like to chip in on eye irritation.

DOCTOR BRESLOW: We do not know what eye irritation is. "Smog" has been defined as that quality in the air which results in eye irritation, less visibility and damage to plants.

Sometimes we thought it was something like cases of typhoid fever, which causes spots on the abdomen, high fever, and diarrhea.

There has been some indication that the eye irritation appears to be somewhat related to oxygen and ozone.

On the days when the oxygen level increases, for the most part you have areas of eye irritation. But that is by no means a perfect co-relation, therefore, we are not convinced that either oxygen or ozone by itself, is something which does indicate that it is the underlying cause of eye irritation.

More than that, we do not believe fully that these qualities of air are the most important. There may be more important causes of air pollution than those three which have attracted the most attention.

THE CHAIRMAN: Such as what?

DOCTOR BRESLOW: We are concerned about three major health aspects, of which eye irritation is only one. We regard the health problem of air pollution as being threefold; first, is the important and obvious interruption of the wellbeing of people, and one is eye irritation. The situation in Los Angeles County would indicate that, we think.

I happened to drive to San Bernadino one day. It is 60 miles east, and for fully 20 miles that smog was pursuing us.

The second is the disaster-making potential. We do not know too much about Los Angeles, but we never had a combination of circumstances which resulted in a disaster such as they had in London, but we have no assurance this will not happen, so we consider that one problem.

The third thing -- and to my mind, perhaps the most important -- is the possible long-term effects of the chronic aspects of air pollution. We are concerned with the effect on the respiratory tracts, the possibility of it being a cause of lung cancer.

These are the problems which, to my mind, deserve the greatest attention.

Up to now, the environmentalists have evaluated

the problem as one causing irritation of the eyes, the loss of visibility -- or, rather, less visibility -- and the damage to plants. So they have worked on the theory that it is an oxygen-ozone relationship, but we are not very sure that it is a perfect relationship.

Furthermore, the oxygen-ozone phenomena is very closely linked with sunshine. When the sunlight is interfered with, as for example, from the heavy moisture or fog near the ground, your ozone or oxygen recorders indicate a very low level of air pollution.

When, as a matter of fact, there may be a greater amount of air pollution, and some of the other substances, such as hydrocarbons and other metals, may have had their highest combination during a period of a combination of fog, low inversion, and light wind.

However, we are not very happy about this combination of oxygen and ozone as an indicator. We recognize it is the best available for certain purposes, but we want to know more about it. I felt I should make this little "pitch" now, to indicate that we are thinking of more important things in the air than oxygen or ozone.

THE CHAIRMAN: You are suggesting that perhaps

there are gases in the air which we cannot feel and see, which may be more serious?

DOCTOR BRESLOW: That may be, and we think there is a situation possibly of that being the case. We all hope not. But we think there is sufficient possibility, so that it should receive our most serious attention.

THE CHAIRMAN: One of the questions we asked was this -- and it is a problem we have at times. We are changing over from steam locomotive coal burning engines to diesel engines. The smoke you can see from the coal-burning locomotives is a dirty black smoke, while the diesel smoke you can very seldom see, and we have asked on a couple of occasions if it was felt that the diesel fumes are injurious to health.

Even as recently as in Los Angeles, the best informant there gave us to understand that there were no harmful effects they could find up to date, from diesel smoke.

MR. ELLIOTT: Do you agree with that, Doctor Breslow?

DOCTOR BRESLOW: I do not know that anybody has identified any harmful effects from diesel exhaust, or any specific type of exhaust, automobile or aeroplanes.

Did you meet Doctor Kotin?

DOCTOR EVIS (Secretary): Mr. Belyea and I went out one morning, but he was too busy at the time.

DOCTOR BRESLOW: Among other things he has done is to identify benzpyrene in the Los Angeles atmosphere, which was done by the English chemist, Waller. This is the most potent cacodylic substance in animals. Whether it is present in humans in sufficient quantity to be important, we do not know, but it has been identified in the Los Angeles atmosphere.

THE CHAIRMAN: This is diesel smoke?

DOCTOR BRESLOW: I do not know whether it comes from diesels or any other type of petroleum, but I would think it would be most likely caused by some petroleum combustion in Los Angeles. I do not think anybody could put the finger on the specific type of fuel such as diesel, but I do not think there is much question but it comes somehow from an incomplete combustion of hydrocarbons.

Another thing which Doctor Kotin has done, which seems more important, is that he also has abstracted substances from the air which, when put through certain benzene processes which, when painted upon animals, will cause cancer, and which produced

cancer in experimental animals. It is biological, and not just chemical.

MR. ELLIOTT: May I ask a couple of questions?

THE CHAIRMAN: Certainly.

MR. ELLIOTT: The town from which I come-- Hamilton, Ontario.-- is a steel town, and in the big steel plant we had about fourteen steam locomotives in the yard doing the yard work, and throwing out a heavy smoke. Today they are all gone and there are nothing but diesels, and yet the boys in the steel mill proper argue that they feel the fumes from the diesels are just as serious, and affect them just as much, as the old, dirty coal smoke formerly did. Do you think that is right?

DOCTOR BRESLOW: I guess you will have to depend on their statements.

MR. ELLIOTT: There is nothing proven that there is or is not?

DOCTOR BRESLOW: Not to my knowledge.

MR. ELLIOTT: In my town, they have gone from coal heating to oil heating in about ninety percent. of the cases.

THE CHAIRMAN: This is a city of about 225,000 population.

MR. ELLIOTT: They are eliminating the black smoke coming out of the chimneys, but the people using it say there is a tendency with the oil to set up a film in the houses, which they think is injurious to their health. We just cannot make some people believe anything different. They have eliminated smoke from the chimneys, but they feel that the oil gas is as injurious, or more so, than the coal, and that from the oil burning in the homes, they get a film, which can be injurious to health.

Those are the two things I have my people asking me about. Many people feel the oil is not as good, and they say that they are getting a film in their homes, the wallpaper gets dirtier, the windows get grimy, and they have all kinds of reasons why the oil heat is not good.

DOCTOR BRESLOW: I do not know the answer to your question, but I would make this comment: it seems to me easier to determine whether there are greater effects from deposits on the walls and windows, and this is subject to experimental observation. You can set up underlaboratory conditions coal burning and petroleum burning conditions, and actually see the difference it might make on the wallpaper, for instance.

MR. ELLIOTT: It is up to the Department of Health to prove that.

DOCTOR BRESLOW: I do not know whether it is the Department of Health which should make the experimental observations. The long-range effect on health will not be solved in the laboratory. It requires a long period of study.

MR. ELLIOTT: A long survey to prove whether it is injurious to health?

DOCTOR BRESLOW: Yes. Yes, we can make provision for getting the material from the air, and applying it to animals, but let me point out to you; to those who are not trained in biology, the mere demonstration in one specie, say, in a small animal, is not clear-cut proof that the same effect will occur with mankind. It is one piece of evidence, but it is not critical to the issue as to whether there can be any effect on man or not.

MR. MURDOCH: How much importance do you attach to, or how much objection is there from your citizens with regard to the effect of smoke and air pollution on the property of those who live in the smog area? Their houses are always smoked up, and it is hard to keep them painted, from the fly ash and so forth, and it does affect the properties. Do you

pay much attention to that aspect, or is yours simply from a health point of view?

THE WITNESS: First of all, our Department and the other official Health Departments in the state, accept no responsibility, nor do we concern ourselves with damage to structures or fabrics. We recognize that as part of the planning job in the state, and since no coal is burned in California, neither smoke from fly ash or coal burning can be a problem.

But here the important concept I think is to remember that we are identical with Los Angeles and our other metropolitan areas in weighing the effect of the smoke which is present, at about one part per million, and that is an entirely different concept than when confronted with the carbon monoxide, at one hundred parts per million.

Your representative from the Bureau of Mines knows that diesel vehicles have been substituted for gasoline-burning vehicles in mines' operations, under the same conditions it would be preferable to use diesels with a low output of CO, and a relatively low output of NO₂, but with air with a perfectly harmless amount of oxides of nitrogen, say one part per million, nobody would suggest that is harmful but to inhale directly would be very important, because of the

chemical processes which go on in the atmosphere because that smog in the Los Angeles is made in the automobiles, and discharged into the atmosphere, is almost incontrovertibly proven.

THE CHAIRMAN: That is a very important point. Would you repeat that?

THE WITNESS: We believe that the smog in Los Angeles is formed in the automobiles, and getting into the atmosphere is a reaction proposition.

BY THE CHAIRMAN:

Q. It is pumped into the atmosphere?

A. It is discharged as smog.

In the early days, I investigated the smog in this state -- in the early 1930's. People would sample it for aldehydes, particularly acrolein, and we were struck with the irritant or lachrymator, but we were looking for ten or more parts of aldehydes, and they were never there.

None of the other air contaminants were ever found in the atmosphere in sufficient concentrations to be individually dangerous, but all together, when acted on by sunlight, they produced unknown but very irritating chemicals. Work now is pretty well pinning it down as an incomplete oxidation process, which is so dynamic that with two hours of no sunlight, the irritant disappears. Probably it is nitrogen dioxide

in the metallic form.

Now, the substitution of diesels for gasoline internal-combustion engines would probably be due to the higher oxides and low hydrocarbons, and thus limit its product, which is a significant thing.

So if you double the nitrogen dioxide and your discharge of hydrocarbons, you would be no further along. The more efficient you make combustion, the lower you go for this condition.

The oxidant when burning natural gas is almost exclusively methane.

Those in charge of the air pollution work in the past attempted to improve combustion processes to the point where smoke would be eliminated, and carbon monoxide in burning gaseous fuel would be reduced to a low level, being an indication of pure combustion.

There is reason to believe that the type of air pollution existing in Los Angeles resulted in part from a rather high level of combustion, and with the oxidation products themselves, rather than that unburned fuel was the cause of the trouble.

For example, natural gas, which is almost pure methane, has in its combustion products not only carbon dioxide, but also nitrogen dioxide, and some

extremely fine particulate material.

There are two things which you do not eliminate, such as nitrogen dioxide, because at certain places, they will be very generously generated.

The other is the acrolein of such small size that they are around three-quarters of a micron, which is tremendously important in reducing visibility because of its scattering effect.

We place a study of aerosols very high in our priority, because we think the particular matter about which we should worry is not the stuff which pollutes the air which blackens the buildings; it is the stuff which has weight, but can furnish a tremendous reactivation, and serves as a vehicle for the absorption, without any chemical reaction of gaseous irritants, transporting them into the lungs, whereas there might be a particle small enough to get in, yet big enough to stay when it does get in. In other words, if you consider the absorption of gaseous material into the human lungs, where the co-efficient takes effect, and equilibrium is reached, the gaseous air mixture will only take on more material as the system transports it away from the reactive surface.

I may postulate, but it is my opinion that in their present form, the particles are weighted

sufficiently so that 100 percent. can be added, and all other materials added on. It is those which explain why smoke in gaseous form has been very significant, but you have to have many such specimens to be certain about the one part per million being discharged into our air, to be certain of its distribution.

BY MR. BELYEA:

Q. That would apply to any of the DC particles we would get in our country?

A. In our work, we began a study of the aerosols samples, which is very crude, because there is the opportunity to exclude the big stuff, notwithstanding the organic content of the aerosol, which we got and analyzed, and particularly the gaseous fraction makes us think that its physical form is important, and the way we develop our concept is this; when you first look at air pollution, you think only of tons per square mile; secondly, you begin to talk about tons of varying components per cubic mile of air, and finally you begin to think of tons not obtainable in a cubic mile of air. That possibly is not good chemistry, but in the final analysis, there may be atmospheric contaminants which may have some effect on the mucous membranes of the eyes, nose and throat.

One other thing in our developing of the

concept of monitoring which we are doing in the two areas, and starting on the third.

We think that involves three things, first, a continuous recording indicating the four things I have mentioned, and adding to that as we go along.

Secondly, a simultaneous measuring of particular material as to particle size and particle numbers in an area, and its chemical composition.

Thirdly, the air volume which we get out here daily, and knowledge of the inversion ceiling, and the topography of the area, which permits us to get the volume by cubic miles, the vertical air changes, the patterns of air movement for the portion not uniformly dispersed, but travelling in a well defined route. This shows the quality of the air chemically and physically.

And, fourthly, the effect of that air subjectively on the human population.

These subjective measurements are the ones which can be made from day to day, in the Bay area, and we will be glad to describe -- if you are interested -- the way we are making daily appraisals of the people throughout the area by a system of recording of the same persons day after day.

The control programme, as distinguished from

the monitor programme, consists of a complete inventory of all the emissions, and, of course, the industrial emissions are the most simple, because you can go to each one and compute its potential.

You must also take into consideration all the emissions from vehicles, house heating, all of which may be important.

When you have determined the level of the air quality, you are desirous of maintaining continuous information, so you are working each day with uniform layers, and you know the sources, so your regulatory programme is based on a pre-determined layer in a well-known area.

We are still pretty vague, but we do know that in the Bay area, from the samples, that there are no good times of the year, and no times of the year when you can take the restrictions off.

If we assume ourselves to be about at the threshold where we want to maintain the present air quality, it means that in every month of the year, we must control the amount of emissions in the air, because we have gone away beyond the point of the highest concept and we do not think it is significant whether that stays at any particular spots in the area itself, as it is a 1 to 2 ratio, and we think it does not make that

difference, as long as it is in the basin. We came to that conclusion in our own work, by the staff taking turns in the highest stations for that day, studying the wind pattern, and we got a sort of giant egg-beater movement of wind.

BY MR. THOMAS (Oshawa):

Q. What enforcement agencies have you?

A. The local Air Pollution District is regulatory, with a permit system which is very tight for industry, and very vague for vehicles, and is absent altogether for homes, but it could be modified.

However, the vehicle question we think has to be planned and developed; it has to be either a modification or vehicle change, with a modification of the transportation pattern; one of the two.

As you came across the bridge today, you saw places where 70,000 or 80,000 vehicles cross every day, with one passenger to a vehicle, and they get into these traffic jams, and that should be remedied. We are reaching a point where we think that nothing should be allowed to cross without having four persons in it.

BY MR. BELYEA:

Q. Coming back to this municipal legislation; was your set-up of your own initiative, or on requisition

from these areas?

A. No, this grew out of the interim legislation and the Committee's studies. Air pollution has been studied by an interim legislative committee for eight or nine years.

DOCTOR BRESLOW: In fact, it was by agreement between the local areas and the State Legislative Committees.

BY MR. BELYEA:

Q. They decided they should have control?

DOCTOR BRESLOW: Do you understand that there was permissive legislation passed in 1947, which is still in effect in any county where the Board of Supervisors find that air pollution problems exist in the district? That permissive legislation, at the last Session of the Legislature, was deemed to be unsuitable for the situation in the Bay area, which is a single basin, but with several counties, and it required counties to get together, and it was worked out between the local people and the State Legislature, that the legislators would pass a law mandatorily setting up the six county districts, with a permissive feature covering the three other counties which did not accept the arrangement.

THE WITNESS: One county had 75 percent. of

the heavy industry, and if they stayed out, it was logical that a permissive system would not be any good if the next most heavily occupied with industry stayed out.

BY MR. BELYEA:

Q. Does any area have any control over an immediately surrounding area?

A. No, the classic example is the Kaiser Steel Mill in Fontana, 20 miles east of the Los Angeles County, with the inability of the county to do anything about it.

Q. In Cleveland, there was an attempt made for the city to have control for one mile.

A. Our counties are large, and this is a good wide district, and it has control over all the cities in the county.

Los Angeles is about 50 miles from north to south, and about an equal distance from east to west, so it is a good chunk of territory, and the actual counties themselves are not the topographical boundary lines.

MR. MAGA: That is one of the strong reasons for forming this district. We are in Alameda County now, and several miles away there is another county which is heavily industrialized, and it seemed well for us

to have a district, when five miles away, there was a district which did not have those studies.

MR. BELYEA: You can require they be included?

MR. MAGA: We will get some maps now, or this afternoon.

Around the Bay, these indentations (indicating) are shown in the centre of the map. The Bay area is surrounded by islands, and the district they have formed delienates that area. It is felt this will be restricted to the area, including any islands.

MR. THOMAS (Oshawa): Is that similar to the situation existing in Los Angeles?

MR. MAGA: Essentially so. In this area, you cannot get one subdivision which covers all the space.

MR. BELYEA: Hundreds of towns or cities, I presume, are too small to be able to engage an officer of their own?

MR. MAGA: That is ~~is~~ the area where there is not a large district?

MR. BELYEA: Not large enough to justify an officer of its own. That is, where it could run and operate as a department.

MR. MAGA: There are several possibilities in that regard. The state law which permits the

formation of the district is related to the county district. There is no state law which would permit a city to activate it. However, a community could pass an ordinance to govern air pollution within a city.

Another possibility is they could pass a law locally, under which this officer might take some action, that is, in a smaller community. With a smaller community, the state agency could assist them in studying the nature of the problem and endeavouring to find a solution.

MR. BELYEA: That is one of the purposes of your District, to advise and assist local agencies?

MR. MAGA: Yes.

MR. BELYEA: If they needed further help in that regard?

MR. MAGA: We extend further help if it becomes necessary, of course, yes. We will extend help to the local communities, if they need it.

THE CHAIRMAN: I think it was a good point which was brought out, that is, the fact that there is no coal burned in California.

MR. MURDOCH: I think we should mention what we are trying to do, on the basis of working --

HON. MR. KELLY: May I clear up a little point? You have an Act passed by the California

Legislature which, in effect, governs the whole state?

THE WITNESS: Right.

BY HON. MR. KELLY:

Q. In turn, there is certain authority delegated to a Board constituted by the Governor?

A. No, designated by the Legislature. In the District, it is the Board of Supervisors of a county, if it is one county.

Q. Then there would be certain funds set aside in the budget --

A. No, state funds. Each county would finance its own problem, with the exception of the Bay area.

DOCTOR EVIS (Secretary): The Board of Supervisors is equivalent to our County Council?

HON. MR. KELLY: Yes.

BY HON. MR. KELLY:

Q. What is the state set-up?

A. In this Department?

Q. Yes.

A. This is entirely investigational, fact-finding, consulting, administration and research, from the medical point of view.

Q. This is equivalent to our Department of Health?

A. Yes. In an emergency, I would be called in,

as in any emergency, but the old concept is that the locally-elected governing bodies of these counties provide for the necessary planning, prevention and control.

Q. To come back to my original idea; your Department of Health provides certain services?

A. Yes.

Q. Perhaps in a consulting capacity?

A. Yes.

Q. And the funds provided by this state have been so provided within the Department of Health?

A. Yes. This year it was a special appropriation; next year it will be a regular one.

Q. How much was put in this year?

A. This year, it was \$250,000.

BY MR. GORDON:

Q. Just for this county?

A. No, the whole state.

BY HON. MR. KELLY:

Q. Do not sidetrack me until I get it on a certain basis. Was that put in, and how did you arrive at it?

A. We drew up a 13-point programme which appeared to us to be the right thing to do in investigating this problem, and interpreting it, and putting

ourselves in the position of helping local agencies to get at the problem.

Q. So it is available?

A. Yes, it certainly is.

BY MR. ELLIOTT:

Q. Your estimates are in there, too?

A. No.

Q. The \$250,000 covers the 13 points, but it is not broken down separately?

A. No, it is broken down by amounts, but we do not have the separate amount on each project.

BY HON. MR. KELLY:

Q. You cannot apply it any place else?

MR. MURDOCH: Mr. Chairman, this Committee is a political Committee, and they are seeking legislation. At the present time, we have four or five communities in our province which have recommended Boards, as it were, in matters of smoke and air pollution, but it is strictly permissive legislation. They do not receive any assistance from our Legislature, although we have some men in the Department who give these local bodies some technical advice and assistance, but there is no compulsion about it.

We have a Board in Hamilton and in Toronto, Windsor, and Sarnia. Some of them operate very well;

others do nothing, and, of course, the citizens of our province say something should be done with air pollution, and we are the fellows who are trying to do something.

I thought we should state our case first.

THE WITNESS: That is the way it is begun.

MR. MURDOCH: Yes. The important point is, it seems to me -- as you know, the province of Ontario has practically all of the Great Lakes system within its boundaries, and we run into the situation of people from Windsor complaining there is smoke pollution coming from Detroit. And the people from Port Huron claim our refineries at Sarnia blow their pollution across the river, and cover their city.

Now, the International Joint Commission has its Advisory Board appointed to make a survey, and they are asking the province of Ontario to go further into this matter. That is the reason for our being here today, and it is on that basis we are asking these questions.

THE WITNESS: There is one point you have not reached in your province, and that is 100 percent. agreement by everybody in the province, that it is a serious problem, and one for rather drastic and dramatic remedial measures. We have just reached that situation

in the Bay area this last year. Prior to that, we had a voluntary programme under no law, and Mr. "Pat" Moran was hired as the Director of that programme. We have just graduated from the voluntary programme into a law-enforcing programme.

MR. MURDOCH: The International Joint Commission had this question directed to it, and they appointed this Advisory Board on Air Pollution, and the International Joint Commission has made a very extensive survey in the International areas, visiting Detroit, Windsor, and other places along the boundary.

I do not know how much they have spent on it, but quite a lot of money, possibly a half a million dollars.

They made a survey as to the effect of air pollution on the health of families, and have made their surveys in smoke areas and power areas.

The study is supposed to last for two years. At the eighteen-months' period, information was compiled, and a brief released, made up to that time, stating that smoke and fly ash and fumes in the air did not damage the health of the people.

DOCTOR BRESLOW: We are somewhat familiar with that study, and, as a matter of fact, a good deal of our thinking was influenced by your experience

with the Detroit and Windsor study. What they were getting at, as was pointed out, was the immediate effect of air pollution on these people. As I understand it, it is based on the current morbidity of people living in the smog and non-smog areas.

In Los Angeles, you had your own experience of eye irritation on the days you were there. There is no question about the fact that in Los Angeles there is such an effect.

Now, it is important to differentiate. There are two kinds of health problems, and the one getting the attention may be the least important. But that is a current and important effect, such as eye irritation in Los Angeles, and the current morbidity in Detroit and Windsor.

There may be very long-range effects which are not being felt by many of you, so there is no health problem, because we cannot measure the immediate effect of morbidity, and it seems to me we need a further statement on the problem.

That was just a gratuitous comment on my part, but I could not let it go by without making that comment.

MR. MURDOCH: I know I am going to have to answer some of these questions when I get back to my constituency, and I was wondering what is being done

in San Francisco here.

BY HON. MR. KELLY:

Q. What about these ships which come into your harbour? Does the legislation of California give you authority over them, or is that a Federal authority?

A. There is some Federal legislation, and there is a co-operative programme somewhat similar to that reached by the health authorities concerning operations like blowing boiler stacks. The shipping problem has not been stressed as it should be, and it should have more supervision, like the big portion of the programme.

Q. Irrespective of that, upon whom does the authority rest; your Federal Board of a State Board?

A. Not with the State, if it is a Federal operation. The Navy, for example.

Q. In our case, both the railroads and the shipping are under Federal authority.

THE CHAIRMAN: That was another question which was raised with the Control District of Los Angeles, and they very definitely told us they can control steamboats and railroads.

BY HON. MR. KELLY:

Q. The reason I asked that question is that we

are dealing with the State people here, and I would like to know which of the regulations are State regulations, and what authority they have under the State law.

A. The State law would apply to the Merchant Marine, but not to the Navy.

BY THE CHAIRMAN:

Q. Has the Control District of Los Angeles the authority to control the smoke in their area?

A. Except the Navy, yes.

Q. That covers it. They have the control.

A. The jurisdiction is that of the State, delegated to them specifically, and it is only limited by our Federal operation, which is the Navy.

Q. One of the big problems, as the hon. Minister pointed out, is coal-burning locomotives and steamships, and that will be accentuated with the completion of the St. Lawrence Seaway, where we will have ships coming into our harbour. We want to be prepared for that eventuality, and we want to give the municipality, through provincial legislation, the right and power to do something about those ships.

A. We went through an extremely frustrating period. In the Legislature, they were bringing down a Bill for separate legislation, and the Legislature

said, "You have a problem here, and a remedy for it with State assistance".

They insisted the situation could not exist where the whole system of air contamination was not understood well enough to cope with.

So they passed legislation giving the power to regulate, and they gave a fine demonstration of the futility of trying to control something nobody understood.

At long last, they acknowledge it is a serious problem, and they have provided limited resources, which have to be constantly planned and managed, and they have given us the duty of learning how to manage it, and at the same time to measure the effects on public health, and they have the full responsibility of discovering that the health effects are thus-and-so.

So our whole emphasis now is to measure the air volume and the chemical properties of the air, and other sources of contamination, to see what is going on, and to do the best we can with our limited resources.

That is why we added a Division under Doctor Breslow. It is not competitive at all. We are both in business, and neither of us depend on the

findings of the other, although as soon as the final medical findings come in, they will apply directly to the public-health effort.

BY HON. MR. KELLY:

Q. The Federal government in Canada has all authority over railroads and shipping, and I wanted to find out if you had authority in the State of California as we in the province should have, or whether your Federal government in Washington would have all of the authority.

A. No; the State government has authority over everything other than the Navy.

DOCTOR BRESLOW: There was some question about the use of funds, and we should make clear these funds come from local forces.

The State does not give the Los Angeles District any money, nor do they give any money to any other District, even though the State called the Districts into being.

It should be pointed out -- although it may be known to you already -- that the powers in California have been greater than in some of the other states. We have local autonomy, and have local funds.

The State does provide funds to augment local funds for welfare and other purposes, but generally, we

are behind Canada in that respect. So the pattern we have in California should be taken into account in interpreting the fact that the state of California does not put money into local Control efforts.

BY MR. MURDOCH:

Q. How is that local money raised? By direct taxation against real estate?

A. Against all assessable property, real and personal.

BY MR. THOMAS (Oshawa):

Q. Would you like to comment on the type or method they have for disposing of garbage by incineration in Los Angeles?

MR. MAGA: The Los Angeles Refuse Disposal is unique in southern California.

MR. THOMAS (Oshawa): You have nothing like that around here?

MR. MAGA: Not to the same extent, especially in regard to the backyard incinerators.

Almost everyone in the Los Angeles area has an incinerator in his back yard, and their garbage is collected separately, but there is no attempt made to pick up the refuse, other than garbage.

In this area, there are more collections of garbage and refuse.

BY THE CHAIRMAN:

Q. Do you burn your garbage?

A. In some places. In Berkeley, they do, but in the others they do not.

The problem in Los Angeles -- and you probably have heard about it -- is that they have controlled many things. They have controlled several obvious items, such as gasoline exhaust. The backyard incinerators is another one.

This year, the Control Board down there established a deadline as of October 1st of this year, as the final date for the incineration of rubbish, but when the deadline approached, the Board held hearings on this matter, and voted 2 to 2, one of the members being absent, and they were faced with the problem of either extending the deadline, or making them live up to it.

The District Board finally decided they would give a two-year extension of time for incineration in back yards. It is the consensus of opinion that there should not be further backyard incineration. It is a source of NO₂, and other pollutants. It is the practice in southern California, and in that locality it may be necessary. Most of the communities in the United States have other means available.

There has been declared a two-year period in which Los Angeles will try to devise a better method of collection.

Q. You do not have it up here?

A. We have it to some extent, but not to the same degree as in Los Angeles. Backyard incineration is a very common occurrence in this area today.

Q. In Los Angeles, the regulations seem to be enforced. There are only certain periods of the day when they can burn.

MR. MAGA: No, there has been a compromise in the Los Angeles area. I believe they compromised, and instead of prohibiting the burning in back yards, they permitted burning at certain hours in the late afternoon.

Also, they can prohibit burning when there is an alert, but if there is no alert, then the restriction as to hours is in effect.

In this area, there is no restriction.

THE CHAIRMAN: Have you any large refineries here?

MR. MAGA: Yes, I think there are five or six. I think the refining industry in this area is about one-third of Los Angeles, and the total population is only about one-third of that of Los Angeles.

THE CHAIRMAN: They said that one of their big problems was that they have four million people, and the burning of rubbish is one of the causes of the situation.

DOCTOR BRESLOW: In any one day?

THE CHAIRMAN: Yes. Whether it is the exhaust fumes from the refineries or the incinerators, they did not seem to know, and they did not seem to think the Air Pollution Control Board knows either, particularly when they will keep "kicking it all over the lot" -- that is, the burning of their rubbish.

MR. MAGA: We think that people should be informed that backyard incineration is one of the causes of the emissions into the atmosphere, and some have said it might happen here, but the Air Pollution Board declared a two-year deferment. You can see why there is confusion.

BY THE CHAIRMAN:

Q. You think your problem will become acute here?

A. There is one fundamental difficulty in Los Angeles, and that is the garbage from residences which is fed to the hogs. Here it is combined rubbish and garbage, which goes into land fill. The reason is on account of the fact that the Bay is

only a couple of fathoms deep, and you can recover excellent land for certain uses by filling it with garbage and rubbish. There is no incentive there. If the collection schedule permits you to put all your refuse in one container, except from the lawns and the shrubbery which you cannot crowd in to a container. They put all their other rubbish on top of it, and people will say, "It is a cinch, they will burn it".

I think some of the horticulturists are people who have an ungodly amount of junk, and if they can burn it, it cuts down the cost. It is a deeply-ingrained habit to burn combustible rubbish.

BY MR. BRANDON, Q.C.:

Q. Do they have an municipal incinerators here?

A. Not here. They have several in Los Angeles County.

Q. They told us they have two they have never used.

A. Did you contact the California University down there?

THE CHAIRMAN: No.

THE WITNESS: They have sent out some reports. They actually had put a very fine incinerator in, with not very much difference in particles per cubic foot,

and it was only a matter of how to get rid of it.

BY MR. BRANDON, Q.C.:

Q. Is it a theory that, irrespective of the backyard incinerators, with the municipal incinerators, they would have the same smoke contents?

A. On this very fine stuff. You can take the actual contents of the air, and take all of the known sources, and accurately compute how many days it would take to fill up to that point, from the known sources.

Our present attitude toward air pollution is that you have to consider the question of incineration, until you can find out how the pollutants get there, you cannot devise an air-pollution programme and make it work. You will be just pointing it out empiracally, as to the way it works.

Q. Have you any instances where there has not been a background of mountains such as in Los Angeles, in this area?

A. If you will look at the map behind you, you will see the whole central portion of the state, some 800 miles long, is the whole Basin and the critical area of pollution in California. So we do not have any enclosed cities with air pollutidn problems now, but that is a kind of useless statement, because we

have no enclosed cities which are not topographically surrounded by a little wall or a big wall.

Q. In the Los Angeles area, we visited an area called "Westchester", where they have said they have no air pollution at all.

A. There are a few little pockets out Santa Monica way, where they feel that because the morning wind motion is landward, and if you are right smack on the Coast, you are probably getting a fresh supply of air to replenish the contaminated atmosphere.

BY MR. THOMAS (Oshawa):

Q. The area is so enclosed that the contamination is diffused over a greater area?

A. You have a confined volume and horizontal air motion. If you confine the air laterally and put an inversion on it, we will naturally have a movement-out of that air, whereas there would be motion and replacement with a lower wind velocity in the air area.

But all of the California cities are either in the central valley, or on the stretches along the Coast.

Perhaps this would be a good time to adjourn for luncheon, and if you desire, gentlemen, we can continue our discussion afterwards.

THE CHAIRMAN: I think that would be a good idea.

---Whereupon at 12:55 o'clock, p.m., the further proceedings of this Committee adjourned until this afternoon at 2:00 o'clock.

A F T E R N O O N S E S S I O N

San Francisco, California,
Monday, October 10th, 1955,
2:00 o'clock, p.m.

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The further proceedings of this Committee reconvened pursuant to adjournment.

All members present, as listed for the morning session.

Same appearances as heretofore noted.

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MR. MAGA: Here (indicating) is a copy of the State programme we said we would give you. This includes the budget, and how it is broken down. This also expands a little on the thirteen points. I am sorry we have not copies for all of you.

Here (indicating) are copies of the State law, which established the Department's responsibilities in regard to air pollution, and here (indicating) are several copies of the Bill, which established the San Francisco Bay Air Pollution Control District.

MR. BELYEA: For the purposes of the record, this is the only State which has adopted mandatory formations of control areas?

MR. MAGA: The only mandatory control area is the one in the San Francisco area. I do not know whether the others have. I think Oregon has a state mandatory law.

DOCTOR BRESLOW: They retain their regulatory power in other states. I think there is a tri-state area, Ohio, Kentucky and one other state, where they established an authority with the co-operation of the several states which are concerned.

MR. MAGA: That is inter-state agencies.

MR. BELYEA: Oregon was set up primarily because of the damage to the crops of the farmers.

DOCTOR BRESLOW: That was one of the reasons.

MR. MAGA: That is under the Department of Health in Oregon.

MR. BELYEA: I think your state is the only one which has a Department set up solely on health aspects.

MR. MAGA: Well, I do not know. New Jersey, I think, has a state law which does not give the air pollution agency at state level a great deal of authority. It has more than we have. New Jersey does not have very much at the state level.

It varies from state to state. Some states have a great deal of control, such as Pennsylvania and

Oregon. This state does not, and I do not believe New Jersey has strong control laws at the state level authority.

DOCTOR BRESLOW: What is the situation in Canada? Is Ontario the only province intensively concerned about it right now or are there some others?

THE CHAIRMAN: The only other province which has taken active steps is Quebec, in the city of Montreal, and Quebec city.

MR. ELLIOTT: I think Vancouver has one, too.

MR. MURDOCH: Would it not be true to say that no real study has been given to air pollution in Canada, but there are certain places, like Montreal and the city of Quebec, which have given it some attention?

Under the Municipal Act, which gives the municipalities power to regulate nuisances in a general way, but specifically smoke, they may have picked out smoke and are acting on it.

MR. GORDON: I come from an industrial city, and we have a by-law, but it excludes foundries and brick works, and they just spew smoke out of them. The reason for that is this: if they said they would have to do this or that, they are afraid that certain factories would move to some other municipality which

has no controls, and they want to keep hold of those industries.

MR. MURDOCH: And the same thing applies between one province and another. And industry could go from one province to another to escape the controls.

THE WITNESS: They are bound to. We have seen it happen. One county had strict regulations, and industry just moved over the border.

BY MR. THOMAS (Oshawa):

Q. I asked that very question in Los Angeles, and I think Mr. Griswold said, "No, the reverse is true".

A. An established industry will not move, but a prospective industry will pick the most favourable situation available, and it becomes relatively difficult.

Q. He said they found it had not worked to the detriment of the locality at all.

A. He is basing that on the fact that the rate of industrial growth has not diminished. I gather pretty largely that is due to the fact that industries come into Los Angeles, as there is no other comparable area competing.

I take it you were speaking of communities where there were tight regulations, and they might go elsewhere?

MR. MAGA: I think Mr. Griswold means that other things are more important to industry than the air pollution, that is, such things as the labour market, transportation and markets for the commodities. They, to industry, are more important than the matter of air pollution.

I have read where the Chamber of Commerce in Los Angeles voted against the location of industries in the Los Angeles area which are air pollutants.

MR. MURDOCH: They have been on the other side of the fence: they just jumped recently.

THE WITNESS: I think they are doing it out of loyalty to the industries which are already there.

Doctor Hutchison is engaged for the moment, but will call back in an hour. His secretary says he expects to hear from him, and thinks tomorrow will be a good day, but she will call back a little later.

We thought it might be of interest to you to see the present current measurement programme scheme in the San Francisco Bay area.

This (indicating) is an aerial photograph, and is somewhat distorted, but this is taken looking eastward from the Golden Gate.

It has one branch in San Palo, and branches into Sacramento. The other goes down toward San Jose.

Each of the red dots indicate a sampler location, where five days a week the total oxidant measurement is made by the phenolphthalein method.

Originally, we had meteorological information of weather, wind direction, visibility and wind velocity. That has been continued, but we have centralized our meteorological assistance, and are collecting it ourselves.

The portion of the map which lies to the right of the Golden Gate, showing all the dots on both sides of the Bay, has developed into 30 districts, which are districts for inspection purposes by the local Health Department, and in each of these Districts, a designated person is continuously going through the area, and noting the reactions as regards eye irritation, nose and throat irritation, and breathing difficulties. It is his own reaction to air pollution.

Separately, for the mornings and afternoons, he records these four variables in three levels, non, moderate and pronounced.

The local Health Department maintains the manpower to collect the samples and they are local agencies which will be called on by the new Bay Area Air Pollution District to continue this work under contract.

We maintain one station at our building here, and have already ordered two stations with four automatic recording instruments for the oxygen oxide, the sulphur dioxide, and the carbon monoxide, and one of these will be a monitor station, which we will maintain, but rather than having it in this building -- which is not a good sampling point, because it represents the air at ground level and immediately adjacent to traffic, so it will be located up on the campus of the university.

The other automatic instrument will go to San Diego. There we will have the automatic record forms for four chemical elements, supplemented by the ones collected at the non-portion of the day, and then add our own measurements to indicate the peak hour of the day for the maximum collection of oxidants and other variables.

As you know, in Los Angeles County, they measure the oxidants; they follow the sunlight, and that falls off in the latter part of the day to practically nothing at night.

We are, therefore, trying to co-relate the chemical side and taking single measurements once a day at a number of points, with a continuous 24-hour record and a central point, and we will add the

collected measurements for these other three gaseous substances as we go through the year.

In this area, we are doing this as a demonstration as to how you would go out monitoring and keeping track of the important variables as a background for a controlled programme, and also a demonstration of extra local resources and we want to give even a fair stimulus in the early stages.

In this programme, when these are taken, we hope to use all their laboratory work. Now, they are doing the straight work. There are four of these aerosols-collecting stations throughout this area. We do not think it is necessary to have fourteen, but we do think it is necessary to have more than one, and the red dot nearest the ocean at the bottom of the map is one of these aerosol collecting stations, and it represents a sort of seaward quality of air, before the city has superimposed its loading upon it.

It represents another principle which is one of our own projects, which is a study of the natural air quality before the city superimposes its load on it. I can tell you about it, if you are interested.

Down below, you can see, in the case of

San Francisco, for one calendar year, the minimum and maximum readings of the four stations on any one day, although the maximums are not always from the same stations. There was no one predominantly high station. They take turns.

So one thing you will see on this chart (indicating) if you were trying to interpret it, is there is a relatively narrow portion of the year when you consider that the maximum did not come up to the normal figures, but another year may demonstrate there is no real fixed figure which you can secure.

This is interesting for this reason: theoretically, if you had no inversion layer, and had no ceiling imposed over the topographic basin, you can get rid of one hundred-fold more times of contamination than of contamination when you have a ceiling down around one thousand feet or less.

This chart (indicating) roughly corroborates the fact that we have inversion, during the year around, in the Bay area, in this region (indicating) something like one-half the days of the year. I do not remember the exact figures. They are in the Committee's report.

BY MR. MURDOCH:

Q. How does that work out in this state?

A. Under the leadership of the state,

predominantly by some eight different local Health Departments, all of which are collecting samples, we pool this information, analyze it, and summarize it, and give it back to them, and we are just getting underway a systematic daily record of meteorological factors, that is, the air volume of that day, and that enables us -- or will do so -- to evaluate the air patterns and motion of that day.

BY MR. BELYEA:

Q. Do you get readings from other parts where there are no industries?

A. No. Some of these points are in the country territory.

Q. But ozone as a result is not naturally --

A. We do not know. The special programme I have mentioned will be devoted entirely to determine the natural occurring levels of the ozone and so forth. We will run that on the map to the Sierra Nevada Range, at about 6,000 feet, and we will find the base line.

Q. Nobody has so far attempted to find that out?

A. No, except one man collected about "four bits" worth of data, and then wrote an article.

BY MR. MURDOCH:

Q. Who prescribes what municipalities will go into a local group? Will there be so many counties or

municipalities?

THE CHAIRMAN: It is in the report, Mr. Murdoch.

THE WITNESS: On this question of the recording of contaminants, Los Angeles and San Diego are only a hand span apart. Vegetables are damaged from Santa Barbara to Mexico. That is all from the Los Angeles, is it not?

This runs out from Los Angeles to San Diego. Some of that in San Diego is north of the region.

There is one piece of summarizing I might make. A good deal of what has been said tends to this conclusion. As we look at the picture, there must be somebody at the state level, but I look at this thing over a particular area, including some of the factors we have mentioned, such as the annual recording of contamination, and the next breakdown has to be pretty much on an air-shed topographic basis, and the actual programme of control has to be done on such an air-shed basis, and must be supported by some state-wide or a wide topographic basis, and has to be further supported by more fundamental information, only a part of which is available now.

As we see it, there is a great deal of work which can now be done very constructively in getting

the prospectus and getting some of the facts about the studies of air qualities in the state, while the research data and the medical effects are being determined separately.

But we were very "leary" of advising the new Bay Area Air Pollution District on what kind of regulations to establish today. If this state gives us a regulation on foundries, and a regulation on refineries, and a law about traffic, and a law about this or that, the time is probably off a few years yet before we can more than sketch it very briefly.

But if an area wants to begin with an enforcing programme, and they are picking out the last of these things which we say have to be done in sequence, it is an awfully rough assignment.

BY THE CHAIRMAN:

Q. How far have you gone with the idea of education and co-operation, before you feel you have to put the finger on the individuals and say, "We have the authority, and are putting it 'right on the line' and you have to do such-and-so"? Or, do you do that?

A. We have not done that. We are in the unhappy state, in a sense, of advising the Los Angeles County District that on their emergency plan, by saying it is probably not the best thing to have this plan,

under your present state of ignorance, when the best ^{is} estimate/ it will be a couple of years before you are out of that state of ignorance.

There are some defects in the emergency plan we could rectify, but to say that there should be probably more of these four things, to represent the levels which justify this type of thinking, and that the third level is where you will find the bodies lying in the streets, is kind of an irresponsible thing to do, because you do not know whether it is too high or too low, or whether it has, in fact, anything to do with it, and it is only with a couple of years of the closest observation of the quality of the air, before you can measure it to what would happen to living things, including people, and before you can calibrate your system.

We are highly in favour of them making the chemical measurements, and giving attention to that, and perhaps that is the way to get your system calibrated rapidly.

But during this period, you pretend to know something that you do not, and God help you if the wrong thing happens before you learn all about it.

Q. We feel that the powers of the Air Control District in Los Angeles are pretty terrific, when a

man can look at some plant, which some people have started to construct or build, or have even finished, and can then walk in and say, "You have to close off operations today; maybe you can start again some time".

We think that is pretty rough.

A. That law is there, because that is the legislators' remedy of the situation up until this year.

BY MR. MURDOCH:

Q. To stop operations in an existing plant?

A. Yes. Up to this year, the legislators assumed that the facts were known, and it required a good, tough policy to deal with the emergency situation.

I think now they recognize that all the facts are not known, and they have to have some programme in the meantime.

But before you assume that Mr. Griswold is carrying the world on his unassisted shoulders, like Atlas, you must realize that when you reach the third level of emergency, he has the authority to do one of two things; he can shut down everything himself, or ask the government to declare a state of extreme emergency, under the Disaster Act, and then he would probably go to the Director of this Department, and say, "What do I do?", and then he does it under his

own powers.

If there is a complete shutdown of industry and transportation in Los Angeles over a four or five day period, it will be the government which does it, under the state of extreme emergency provisions, and we will have to act accordingly.

BY THE CHAIRMAN:

Q. I was not referring to the whole area, but to one plant.

A. That plant can appeal to the Appeal Board.

Q. In the meantime, is he closed or open?

A. No, the appeal is a stay, while the hearing is on. The Appeal Board may grant a variance of time to put in the proper machinery to provide the remedies, and I think the law contemplates that where extenuating circumstances appear, steps can be taken to save the industry from being shut down.

If there is a known remedy, perhaps a question of establishing a baghouse, or installing an electronic precipitator, they would give him time to instal them.

Q. I gained the impression -- and it may be erroneous, and I am making no inferences about the job they are doing -- but I gained the impression that if a firm was coming from New York, for instance, to build a big plant in the Los Angeles industrial area, about

the first thing they should do would be to check with the Air Pollution people regarding the actual construction of their plant, and so on?

A. I think that is probably right.

Q. That is pretty broad?

A. Extremely so.

BY MR. MURDOCH:

Q. It was just mentioned by our Chairman that the last people to be consulted by a new industry might be the Air Pollution Board.

A. No; he said, "The first and last". I think he meant in the everyday association.

Q. We have a Factory, Office and Shop Act in Ontario, and I assume you have on here, where our Labour Department very closely watches all construction of buildings, two storeys in height or more, with regard to fire hazards, fire escapes, and all those other matters, and it probably could add this on to that.

A. It is to protect the workers inside of industry. We have a parallel to that in our County, called the "Safety Industrial Relations Act". They have requirements for air pollution conditions, but that does not protect the community itself from the emissions outside.

Q. Would it be possible to set up a Board of

that kind?

A. It might have some advantages, but it is not the same problem on a large scale over the entire problem because of two things.

In the first place, in the industry, there is always a remedy, which is to capture and collect the discharges, and you know exactly where the materials are coming from, and you have everything under your control at the plant. When you build a factory, you know what you will be contending with.

But another factor is not only to capture materials from industrial discharges from stacks, but the emissions from vehicles, or many other things, and trying to ascertain the reaction that is going on in the atmosphere after these things are discharged into it.

The remedies are quite different. The industrial remedy is fundamentally a plant remedy in each industry, and is only one of many, many businesses.

The other thing is the practice of the Labour Department to consider this matter as a broader problem.

Q. Our province is growing so fast that we have to sort of overlook things occasionally. Looking at it from the political point of view, I think it belongs to the Department of Health, rather than to the

Department of Labour.

MR. BELYEA: The Department of Labour does refer certain things to the Department of Health, and I believe our municipalities occasionally can require plans to be given to them, but almost invariably the plant is constructed without the municipality knowing about it.

The Department of Labour invariably knows about it, because they have a large staff of men who know the district and who know what is going on.

THE WITNESS: That is interesting, but speculative.

MR. MURDOCH: You have to apply for a permit before you can build any building, and the trouble we run into is that the municipality will want this plant, but our Provincial Code is pretty stiff, and it would be much more stiff if it included air pollution.

MR. BELYEA: The Department of Labour has a permit system, for which a fee is collected, and they do not miss anything.

MR. MURDOCH: Then we have municipalities objecting to the rulings of the Department of Labour, and the Provincial Government does not want that to happen to them.

You just cannot go out and take a survey, and

look at this thing, and issue rules and regulations. You must be prepared to answer all the questions first. I think the place to start with is getting the basic knowledge and ascertaining the existing rules and regulations. That seems to be very apparent.

THE WITNESS: Yes; you have to almost compute what the air motions are in your topographical basin and what can be handled on that basis, and go at it like a water pollution programme, rather than to point out what a good looking stack or a good looking plume there is, because that has very little to do with it. That is a totally inevitable loading.

DOCTOR BRESLOW: We have emphasized the possible long-range health effect, and we hope there will be sufficient demands, meaning if we take action before the evidence is in, we will never find out what the long-range will be.

There can be steps taken, as there are in Los Angeles, to control a good bit of pollution, even before all the evidence is in, as regards the ultimate health effects. But we certainly would not suggest that any action shall be taken until all the medical evidence is in.

We think we are getting legislation too rapidly, and we think they should perhaps wait a little

while until all the evidence is in.

MR. MURDOCH: The other point is -- and this is a significant thing to me -- and I am not from the northern part of the country; I am from the southern part --

THE CHAIRMAN: Where are you located from Detroit?

MR. MURDOCH: All of my constituency is located south of Detroit. We are about on the same level in my County, as where we are right now.

Here is a point -- and I think it is quite important -- that hearing what you have told us, and with the study you are giving to the health of humans, but here is the point; we have something already that compensates the farmers for these dangerous sulphur fumes, but have we ever spent any money to see if the fumes are harmful to humans?

HON. MR. KELLY: I do not think we have spent too much money that way.

THE CHAIRMAN: That is why we are going up there.

MR. MURDOCH: If we are going into this in a general way, we will have to get that under consideration.

HON. MR. KELLY: That will be up to the

Department of Health. We are interested in revenue for the Department of Mines. They take all the money we make in the province, anyway.

THE WITNESS: Has your group become appraised of the observations made in this state of the effect of oxidants other than sulphur dioxide, on vegetation?

THE CHAIRMAN: We heard from a Doctor Bobrov, and it was very well done, too.

THE WITNESS: There is a documented biological story, not on living things, but on plant biology, but very little on animals and humans yet.

The reason that is in our legislation here is the physiological effect on vegetation, but we look on all things as a spectrum, and we think that very often plant damage has some influence on the damage to humans.

HON. MR. KELLY: We have a report of that filed. I filed a report to the effects on plant life, from the plants around Sudbury. I read a bit of it.

THE CHAIRMAN: One of the early studies of sulphur dioxide, and leading to other things, contains the actual figures.

THE WITNESS:

Right here, the American Smelting and Refining Company was put into operation about 1900, and they are roasting certain materials, and also

extracting bismuth. They had a great deal of damage in this country and some livestock killed.

So a Commission was appointed to study the effect on animals, vegetation and humans.

They erected a 400-foot stack, but it was not enough, and they erected 209 feet more, and there was an emission there which affected quite an area.

BY HON. MR. KELLY:

Q. Did the 600-foot stack clean it up?

A. Yes. They maintain them on three hills about 120 degrees apart. They took over a five-years' continuous recording, every fifteen minutes, with sulphur trioxide, and more recently they expanded it to sulphur dioxide, and to sulphuric acid independently.

The single emission affecting quite an area came up about five years ago. They now think that the composite emissions are loading up the whole air masses.

MR. BELYEA: Do you register the measurements? I mean the measurements of the heights.

THE WITNESS: Yes, four times a day, to determine the heights of the inversions.

BY MR. BELYEA:

Q. Would that stuff go above the inversion level?

A. It could go above the base of the inversion, but not the over-all load.

The base sometimes gets as low as 400 feet or 500 feet. The load itself is a couple of thousand feet.

Q. It would be helpful to get the inversion load?

A. Yes, but it might drop it there. It might hold it in the inversion load. They were trying to get above the surrounding landscape.

Q. What is the lowest inversion you have on record?

MR. MAGA: We had one month -- September -- in which there was an inversion every day, except one.

THE WITNESS: Would they differ any?

MR. MAGA: Yes. The first I mentioned was when I was asked a question about the relative problem of this area with Los Angeles. In September, the inversion was at a maximum of 500 feet at one o'clock in the afternoon. It was on the ground throughout the night, from one a.m. to seven o'clock in the morning. They make the measurements from one to seven. From one o'clock in the morning until seven o'clock in the morning, it was on the ground, and it lifted to about 500 feet about one o'clock in

the afternoon, and returned to the ground again at seven o'clock at night.

MR. BELYEA: Do you measure the inversion at night?

MR. MAGA: They are measured at the airport at one a.m., seven a.m., one p.m. and seven p.m.

THE WITNESS: The radiation inversion which comes every night was relatively easy, for the sun to burn off. But if you get a substantial night inversion with a thickness of a couple of thousand feet, that is a real "stinkaroo", compared with the one which goes down when the sun goes down.

MR. MAGA: This inversion is very thick -- a couple of thousand feet in thickness.

BY MR. ELLIOTT:

Q. Does the rain tend to clean the smoke up?

A. We do not know. In this area, rains come between November and March, and last winter was the first time we went through the area in January and February.

This low period (indicating) of maximum oxidant readings, came in the rainy season.

MR. MAGA: We know during the rainy period, there would not be the smoke, because you remove this so-called "inversion".

MR. ELLIOTT: That brings all the stuff down?

MR. MAGA: You could have serious smoke periods between the rain periods.

MR. ELLIOTT: Does that help matters out? Would it have a tendency to clean it up?

MR. MAGA: I think it would. I imagine it would be associated with the low pressure on the weather map, which would indicate no inversion.

THE WITNESS: Your question was, would the drops of water falling through the air have a cleansing action, that is, a scrubbing action? The answer is, we do not know. When the weather changes due to the rain, other things change, too.

Last year, on the night work, they were recording weather, and were getting a bad smoke after the rain, but not while it was raining.

BY THE CHAIRMAN:

Q. You do not have these smog alerts here in San Francisco?

A. No.

BY MR. MURDOCH:

Q. Sometimes the Chairman of our Committee is quoted in one of the Metropolitan Toronto newspapers as being quite concerned with the work of this Committee

and with the radioactive fall-out. Do you take any interest in that?

A. In this state, the Office of the Civil Defence Radiation Department maintains seventeen stations where daily measurements of the fall-out are taken. Our only information comes from the aerosol samples on which radioactivity is measured.

We are also receiving the twice-a-day information of the fall-out pattern from any of our areas, as a source from the centre of the circle.

During the Nevada atomic tests, when we received from the Office of the Civil Defence information that the wind directions were such at 40,000 and 20,000 feet toward California, not only were our efforts re-doubled, but we began to make measurements of rain and snow and so forth, and picked up a very measurable amount in rain and snow.

The Civil Defence people were measuring the air direct. There is no question about it.

BY THE CHAIRMAN:

Q. You found then that these blasts contributed to the pollution of the area in this District?

A. The tests were sensitive enough. You can detect the effects from Nevada, in an hour or so. It did not reach dangerous levels. Our air was not

dangerous to breathe. I do not mean to infer that. But you are speaking of the radio fall-outs. We were able to detect them.

BY MR. MURDOCH:

Q. How long after the blast, would you be affected?

A. I do not know. Our samples were collected in the ensuing week.

As soon as we began to see that a fall-out was occurring, we went and sampled the snow, and in a couple of instances, the rainfall.

Q. My thought was if you had snow falls as we have, and you thought they were affected by the atomic explosions, you could measure the snow at the time, and if there was any test to show that they started to come evenly, possibly they would become a little heavier later on. You were not advised of that?

A. No.

Q. You took them at certain times afterwards?

A. We are running routinely, on the surface water source. Our water supply comes from Nevada, from the large reservoirs, and in the terminal reservoirs, it is merely routine. One or two we think will adequately cover the state. It was merely a token effort. In fact, this air pollution effort is very

token, considering the size of the job, that is, the part of the air pollution which we recognize. It may be a part of the air pollution, with no background levels.

It is a public health service. Aerosols form a measurable amount of radiation, coming from every station.

DOCTOR BRESLOW: You gentlemen must be aware of the fact, from your questions, that a good many biologists study the effect of the radiation which has an effect on human and other lives, and they have begun to revise their ideas of what is safe and what is dangerous.

DOCTOR EVIS (Secretary): You mean they are lowering the threshold?

DOCTOR BRESLOW: Yes. We know so little about the genetic effects of radiation, and some of the great geneticists are raising quite an alarm as to the very dangerous increases in the so-called "moderate background radiation through the atomic blast fall-out".

There are other industrial uses of radioactive material, even through the medical therapeutic uses of radiation, for people who are exposed to it.

The whole question is now being revised and

the ideas we had heretofore are being subjected to very rigorous examination, and the idea seems to be to lower the tolerance.

MR. ELLIOTT: In Los Angeles, they seem to think the automobile is responsible for 50 percent. What would be your opinion?

DOCTOR BRESLOW: They were speaking about something else. They were speaking about pollutants of all kinds, and an estimate of the amount and size of material which the automobiles in Los Angeles put out every day, which amounts to something like 1,200 tons of hydrocarbon. And one can compare this with the amount of hydrocarbons emitted by the diesels and various other sources.

But we do not know really what harmful effects there may be from these various kinds of hydrocarbons.

MR. ELLIOTT: They claim that 50 percent. of their smog pollution right now is from automobiles, and they indicate that the incinerators cause another 15 percent., which makes a total of 65 percent., and the balance of 35 percent. comes from all over the industry.

Do you think that would fit into the picture here?

DOCTOR BRESLOW: I cannot say anything different, as I think perhaps they are basing it on tonnage, but the point is that I do not know whether one ton of stuff from automobile exhausts is the same or greater or of a lesser amount than what is coming from other sources.

I think it is misleading to compare the tonnage amounts and to say that 50 percent. of it is from automobiles, and so much from something else. We have not reached the stage yet where I think anybody can specifically apportion the amount of the material.

I was speaking here about the radioactivities.

MR. MAGA: You may be like comparing a ton of apples with a ton of lumber and a ton of wood. They are all tons.

THE WITNESS: The general presumption you always make is with tons, and then you distinguish between the chemical constituencies of those tons, and the thing which has not been done yet is to determine the effect on the human system. There is no criticism against beginning your inventorying in that way.

BY THE CHAIRMAN:

Q. Have you a plan in California for the use of atomic energy for hydro and things of that kind?

A. No, but there are reactors to be built in

California.

Q. For what purpose?

A. Only for medical purposes, at the University of California in Los Angeles. I do not know whether there are any power projects planned.

MR. MAGA: The P.G. & E. -- that is, the Pacific Gas and Electric -- is very much interested, and one of the agencies is working on the use of atomic power, so we may safely guess there will be some.

BY THE CHAIRMAN:

Q. They are coming along the same way, and that points up again what you said, Doctor Breslow, in regard to this study of radiation, that it is one of the big possibilities of your over-all air pollution problem, because it is one you just do not play around with.

A. We have a dual responsibility for the first time under the legislation of this year, to give attention to the disposal of radioactive waste, and as we try to look at ourselves as a dynamic city, we must keep the material balanced, and what the effects are.

In regard to radioactive material; we feel we must keep track of how much is present in the state

and circulating.

We have run a modest number of water samples. We used samples from the Metropolitan area, to see what is going through the liquid cycle. At a somewhat later stage, we figure what fall-out would be on the land, and would affect the vegetation.

It is a changing situation, and you have to keep the materials balanced with it. There is a quantitative knowledge of what is coming into the state, where it is from, what its power is, and how it is re-cycled, because more and more is being re-cycled, rather than being carried out to sea.

BY THE CHAIRMAN:

Q. Coming from the fresh air of Ontario into the smog of Los Angeles, I can well understand how a parent would be worrying about his children, because when you drive through the streets, and your eyes are watering, and you feel a tickling in your throat every time you breathe all day long, I cannot imagine how people would raise youngsters in that atmosphere, if it is that way every day.

A. Doctor Breslow has thought a great deal about the way of measuring human responses by some other method than illness, and the interference with the farming. Perhaps he would like to elaborate on that.

DOCTOR BRESLOW: One of the things we hope to do in Los Angeles, besides looking at the morbidity of the whole population, or certain segments of it, for example the older people and those who are frail -- is to look at the morbidity similar to what is being done in the incinerator studies, and we are going to try to assess the effect on the farmers.

We are not getting under way this year, but by next season we will be underway.

THE CHAIRMAN: Due to lack of funds?

DOCTOR BRESLOW: No, lack of manpower time. We just got started a few months ago on a permanent basis in this field.

We want to look at, for example, many school children and their daily performances with respect to the severity of air pollution. We have had reports from school administrators to the effect that the children in school simply cannot concentrate on the tests when there is severe air pollution. They were antagonistic and quarrelsome, and got into "scraps" in the schoolyards, and were not able to function properly.

Some children said they could not read as much; they had to have longer rest periods, with their faces in their arms, and had to rest more frequently.

This is all subjective, but it is interesting.

We hope actually to make tests of school children each day for a certain number of minutes, and have them perform their exercises, arithmetic or any other type of elementary school exercises, in such a manner -- and this will have to be worked out with the educational experts -- that one can see whether their performances on a certain day are better or worse than on the day before.

Then during the period of the smog season we could see whether there was any difference between the performances of the school children which was on measured tests, and the high quantified relation to air pollution.

We will do the same in this regard as we did in connection with industrial performance. We hope to take measurement of some things in which there is a good deal of variation, and to learn the effects on the children during their emotional set-backs. That will require that we measure hundreds or perhaps thousands over a certain number of days.

If there is any appreciable effect on human performance, we expect it might show up, and we hope in another year to get that underway.

We have underway one project which might be

of interest to you and which pertains to this, and that is the study of the effect of air pollution on respiratory performance. It is obvious, as you breathe the stuff in that a person whose lungs are already impaired in their function, from various lung diseases like emphysema, might not perform as well. It is the subjective values you get from some tests of certain numbers, as to whether a person is performing better or worse.

In Los Angeles, we have a medical officer at work trying to devise tests -- from those which are available, with modifications of course, of those who have a diminished respiratory reserve, which shows the effect of air pollution.

For instance, a person may have on the regular days -- a respiratory rate -- let us say, the ordinary person performs at the rate of 100; he may perform customarily at about 60 under certain conditions.

We want to watch over them for a few days and see what happens on the air-pollution days. We are establishing air-conditioned rooms under ordinary air conditions, of a type of air conditioning using charcoal filters, from which they take out these things from the atmosphere, as far as we can do it, and we will see whether taking a person out of the Los Angeles

atmosphere, and putting him into a clear-air room for a few hours -- whether there will be any recovery.

I mention these to give you an idea of what kind of things we hope to do.

THE CHAIRMAN: That is very interesting, Doctor Breslow.

It stands to reason, speaking of the effect on school children, that if you take a hot day, when every breath you take is difficult, and there is eye smarting, that they are not in a position to do a good day's work. It affects the whole economy of the community.

You have not the urge to do anything with that at the present time?

DOCTOR BRESLOW: No. Possibly the evidence we have already may be of interest.

You have heard about the chemical system of alerts in Los Angeles, which is in three stages, and it is the thought of some of us that perhaps some real drastic action may be necessary, and that is being given consideration by the biologists. It is in relation to something which is happening to human life, and we think perhaps people will become obviously ill or die before there will really be imposed the drastic powers which have been contemplated.

We feel since people will be seeking such a biological indices, we should try to establish a biological index.

We are trying to keep a daily observation of 4,000 patients in nursing homes, who are, for the most part, seventy years old or older, patients who are quite frail, many of them bed-ridden, and can be carried off with very small changes. They die off at a very high rate. We watched that situation closely in Los Angeles the first week in September. The mortality amongst this population rose quite markedly during that period. It does not rise very markedly at any other period.

Another thing is we are taking a look at several thousand employees in several different plants. We have no direct measure of the efficiency of productivity, but we are simply ascertaining the number of persons on each day who are observed visiting the nurses or the doctors' clinics for respiratory complaints of any kind, the eyes, nose, throat and lungs.

Ordinarily, on any one day, the number of persons who visit such a clinic is well under one-half of 1 percent. That is on a daily basis.

During the period when there was relatively high temperatures in Los Angeles, the rate went up very

substantially. So at least there was the loss of time of a man, in going from his place of employment to the dispensary, and coming back again.

THE CHAIRMAN: With the consequent reduced productivity?

DOCTOR BRESLOW: Yes. He was not working at his place when going to the dispensary, and it represents a great loss of time. Of course, there are others who do not go to the dispensaries, but they just "cuss" it out, but they would not be performing much actual service.

MR. GORDON: Do you think in connection with a number of these complaints, that they are imagining these troubles are happening to them?

DOCTOR BRESLOW: There is no doubt about a certain psychological complaint. When a person says he has a headache due to the smog and feels depressed -- and that is important; we only get some information through these individual statements that it is due to the smog -- of course, there may be just as many headaches next Tuesday as on last Tuesday, but next Tuesday it may be due to something entirely different.

MR. ELLIOTT: Coming back to Los Angeles for a moment: supposing things do not get any worse in the next five years, people will perhaps have accepted

this as a general condition, and think nothing of it.

DOCTOR BRESLOW: That is one point of view.

HON. MR. KELLY: You cannot go on what people write in, because in the Noranda Mine, they did not put in this aluminum dust treatment for silicosis, and we had a curious thing happen, that where some miners accused us of using them as guinea pigs in the Porcupine Mine and the camps, the other fellows in Noranda were asking us why they did not get the same treatment.

You cannot win either way.

MR. BELYEA: Doctor Breslow, you have been talking about the possible health effects in areas where there is smog, or after some prolonged temperature inversion, where the contaminants were built up to several dozen, or perhaps a hundred times that of normal life; if there is some doubt about that having a health effect, and does not prove what you say about an area like the average eastern state, which never have temperature inversions or perhaps only for just a few hours at night, would it not seem very unlikely that you could call it a "health problem"?

DOCTOR BRESLOW: I am not a meteorologist. I think they should try to answer that.

MR. MAGA: Sometimes they have some very

severe temperature inversions in the east, when you have outbreaks of cold, coming down from Canada.

MR. BELYEA: I have been trying to check and I found that Cleveland has checked for a number of years, and the longest they had was eight days.

MR. MAGA: In general, the midwest and east have temperature inversions which last a few hours, or less than an hour, but occasionally they get one of these so-called "high pressure areas", which may be somewhat prolonged.

They have had some high pressure areas in Texas, and it has a great deal of industrialization, and heavy industries at that.

They have sometimes prolonged inversions and there the country is very flat, and they have no laterals restricting, and apparently the higher winds keep transporting the stuff out.

BY THE CHAIRMAN:

Q. You are not prepared to say, Mr. Stead, that California is in a position to advise very much on it?

A. I know one point which I might bring up, and it is this: last month, there was what was called a nation-wide conference back in Cincinnati, to which every state was asked to send representatives. When we got there, it was found that there were three groups

of people with different attitudes, one from the east coast, who had been for years under a smoke-control and some abatement programme; the industrial hygiene people, concerned with indoor conditions, work rooms, ascertaining the maximum allowable concentration about twenty or thirty times as high as you have encountered out of doors.

Then there was the small group of people concerned with the type of thing we have in Los Angeles.

It was found they were so far apart in their attitudes and approaches, that there was need to get some common denominator, as the smoke abatement people have concerned themselves very largely with the cleanliness of the air.

Q. That is the stage at which you are today?

A. Their yardstick has been the fall-out measurement in terms of tons per square mile.

It is utterly impossible to co-relate tons per square mile with fall-out, or even tons per square mile of materials which have remained suspended in the air in gaseous form.

So the proposal was made in connection with a common denominator, that we were concerned with the type of air pollution in this Los Angeles area, and with these aerosols, that is, the fine particles in

the air, collected into boulders and chunks, which would fall down and land on the sidewalks.

Therefore, in our recommendations, we suggested that the problem of aerosols be given some consideration, to determine them by themselves, rather than after they have had a lot of boulders formed in them.

That means you would collect your samples in a continuous filtering sampler to begin with, and later, with a thermal precipitator, to determine the particle sizes.

But, at least, let us measure the cleanliness by what is in the air, rather than by what has fallen to the ground.

MR. MURDOCH: I see smoke coming up from the smoke stacks, probably more than I have seen in the past few days. Oh, I see; it has something to do with the anatomy building?

THE CHAIRMAN: Yes, they perhaps have the same condition we have, that the public buildings are the worst offenders.

BY DOCTOR EVIS (Secretary):

Q. What would you say about the different agencies touching this problem? The engineers in our Industrial Hygiene Branch say there cannot possibly be

any detrimentally-ill effects from air pollution because the level of contamination was so much below the factors they run into all the time.

Would you care to comment on that?

A. Yes. When we personally became interested in air pollution, back in 1931, we found that in the early 1930's in Los Angeles they would have it two or three times a year, and this index (indicating) -- and I will summarize it,--and on those days they would take samples of sulphur dioxide, sulphur dioxide and formaldehyde, and the usual things which had the M.A.C. -- which were irritants - but they would never get one part per million.

So most people assumed it was just some mysterious substance which we had not found, but when we found it we would know it, because the only thing which could produce this traumatic effect on the eyes would be something which we would find in the order of 20 or 30 parts per million.

This retarded the development for at least ten years during which they have been searching for the 20 parts per million of an unknown substance.

Only a few years ago, we finally began to reconcile ourselves to the fact that there is not 20 or 30 parts per million of anything that is significant,

and we have to hunt for something which can produce the traumatic effect with one part per million or less.

The one part per million in a cubic mile of air is still many tons, so the problem remains very important.

On the other hand, you were looking for a thousand tons per day or more of something, but it had to be something with one part per million or less, and which had this traumatic effect.

It seemed impossible, because of these things discharged, none of them fit this condition, and it was only when we realized we had a reaction in the atmosphere, perhaps of an oxidation type, that we began to further enquire into it, and when we pinpointed up the two, then we realized it was very unstable, and then we began to get some idea of how this apparent paradox could exist.

It still exists, because with these industrial hygiene samples, we had to use a method which consisted of putting a large amount of air through a sampling device, and in the device for the absorption of waste into the collecting device, and we found there were many, many cubic feet of air involved.

There is absolutely no hope of knowing that the impurities left in concentrated form in the collecting device are the same as were in the atmosphere,

because the dynamic energy is entirely different than the dynamic energy which goes on in the test tubes, in a chemical laboratory.

So you will really not completely understand the compounds which are actually being inhaled from the air, until you examine them in vivo, that is by testing with a spectograph with different lengths, or some way of identifying the different sources of energy, while they are at the ambient air form.

Frankly, that is the reason why we have proceeded with the development in the last year of what we call the "environmental testing facilities", by which, to all intents and purposes, we have enclosed a large area -- maybe 10 or 20 acres in extent -- and in that area we have created true smog just the way it is created in the normal Los Angeles Basin, and having a proportionate number of motor vehicles discharging various emissions, and we will either use natural or artificial sunlight, and we will let the smog dynamic phenomena develop and there will be a full development of vegetation and normal life, so it will be, to all intents and purposes, a chunk of the Los Angeles Basin, and that is where we will do our co-relating work, by measuring the effects on humans and animals, but what is more important, measuring the effect of some of

these measures for restricting vehicles or restricting incinerators, because we can put and take at will.

But I point out that is the reason why I said earlier that I did not think it was necessary to take the Industrial Hygiene talent, and apply it to the outdoor air in the same form.

I think we will have to look forward to undertaking a new and extreme microscopy, and an entirely new adoption of the spectograph method, because we have to study the ambient air while it is in balance.

BY MR. MURDOCH:

Q. Just along that line; it could happen that new industries manufacturing new products, giving off new gases or fumes, or new processes like the development of the catalytic processes in the gases from the oil drums, and some changes in industry, could produce changes which would be very significant.

A. Supposing we reproduced the Los Angeles mixtures, some small, small intensified, but in the same proportion, would it not be tremendously valuable to try out the 50 percent. reduction of sulphur dioxide to see what effect it has, and try out the elimination of the smoke-producing operations or combustion, or possibly the radiation? We might be surprised. We

might have a dynamic balance of reaction, or perhaps we might attack it from the wrong side of this teeter-totter, and make it worse.

Or if somebody came up with an additional neutralizing addition to the air? There are so many variables that we have the opportunity to empiracally treat things on a somewhat technical basis, and yet hope to make the decision as important as the decisions being made in Los Angeles.

Q. The need is there for something of a catalytic nature --

A. Look at the so-called catalyst such as are used in the oil refining industry and what was not fed into the thing was escaping into the outside air.

Q. Another point I would like to mention. On the train, we were in conversation with a lady who came from Windsor and who was taking her husband to England many years ago, and the doctor said, "Do not take him to England; he will only last a short time. You had better take him to California".

So she came out here, and he was here thirty or thirty-five years. I did not ask whether the husband was still with her or not, because I was afraid to go any further along that line.

I also spoke to a man in Los Angeles who

said that some people are getting quite concerned about this smog. They can move out if they want to, but there is a certain effect on the health of the youngsters and so forth, and they are wondering how far it is going to go.

There is a psychological effect on them, if they have a couple of children with asthma, and this condition seems to aggravate that.

What I am getting down to now is a final point, and that is the medical doctors: are they quite concerned about this, or are they just taking a passive interest in it, or are they really concerned and are they offering any spontaneous suggestions?

A. This may sound frivolous, but the last people to acknowledge that this was perhaps a public health programme were the officials of the Public Health Agencies, and next to the last people were the members of the medical profession. The rest of the population have the conviction, as I said in the first place, that they will be "caught by the seat of their pants", so to speak.

In regard to your question about people leaving Los Angeles, and getting back to the point Mr. Elliott mentioned a little earlier, that people get used to it:

California was not settled by the gold miners. That was but a small percentage of the population. The real immigration to California came about 1885, when the railway came through, and they were selling lots in New York for \$10,000, which were about a mile out under the ocean. They realized soon that in this state was the soil and the climate, and the big immigration came because of the climate, and the people were sorry when the mountains disappeared and then the sunshine and the blue sky disappeared, and they first of all got mad, and more recently they have become quite a little scared -- put it that way -- from the fact that their climate has been taken away from them.

Q. The mountains disappeared because of the inversion?

A. Yes.

BY THE CHAIRMAN:

Q. You said it was a frivolous statement --

A. I said it was, because we were the last to learn. However, seriously, I do not think it is too frivolous.

Q. We have all heard and read about "Sunny California". We have heard that for many years.

After being here and living with it, quite

frankly you do not have any.

I can see why the native Californians, and those who have lived here for years, would be just as sorry as they possibly could be.

A. The emigration is more than counterbalanced by the immigration, but the hotels where people formerly came for the winter -- such as in Pasadena -- are empty.

I went into the Hotel Green which was one of the popular hotels, and I was dumbfounded because it has always been chock full of people during the season, and it looked just like a morgue, and in talking to the hotel manager, he said that was true of all the winter hotels.

THE CHAIRMAN: Mr. Stead, I am afraid we will have to call this off as we have an appointment with Professor Tebbens at three o'clock.

MR. BRANDON, Q.C.: Mr. Stead and associates; we have enjoyed your remarks very much, and we have noticed the diversified thinking, as compared with some about which we have heard before.

However, I know when we go back to Ontario, we will have gathered a great deal of information here which will prove most fruitful in our own province.

MR. STEAD: We were delighted to have you. I know Doctor Merrill will be disappointed, and I do

hope we can exchange notes by mail, if not otherwise, because we are all interested in this matter, and would be glad to assist you in any way we can.

THE CHAIRMAN: Thank you, very much.

---Mr. Stead and associates retired.

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---Whereupon a short recess was had.

---Whereupon, at 3:55 o'clock p.m., the further proceedings of this Committee convened in the office of Professor B. D. Tebbens, Assistant Professor of Industrial Hygiene, at the University of California.

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B. D. . T E B B E N S

Assistant Professor, Industrial Hygiene, University of California, but not being sworn, deposes and says:

BY THE CHAIRMAN:

Q. Professor Tebbens, we would be glad to have you proceed in any way you think desirable.

A. I am trying to establish here what your major interest is. You are a group of Legislative Assembly men?

MR. MURDOCH: That is right.

THE WITNESS: It is called by a different name?

MR. MURDOCH: We are in the dual capacity of the Legislative Assembly, and the Senate.

BY THE CHAIRMAN:

Q. This is a Select Committee set up by the Ontario Legislature to study all phases of air pollution and smog control and report to the next Session of the Legislature. Briefly, that is why we are here.

A. That is a big job. My particular interest is very largely a technical interest in that actually I teach a course in air-pollution control in the University.

Basically, we have to start out with the engineering people, to give them an acquainticeship with the characteristics of air pollution, but we do not know all about it.

In addition, in the University, we have a Bureau of Public Administration, which has done some work to try and pool together the legislative aspects of the air-pollution control, and I had arranged with Mr. Scott to see you on Wednesday, but perhaps if I call him now, he may be able to come down today.

DOCTOR EVIS (Secretary): Mr. Maga was going to try and arrange with Assemblyman Eyron Rumford to meet us on Wednesday simultaneously with Mr. Scott.

THE WITNESS: Perhaps if you could be here

on Wednesday, that would be the best time to see Mr. Scott.

DOCTOR EVIS (Secretary): Mr. Maga was going to ask Mr. Rumford to perhaps come to the hotel to see the members of the Committee.

BY THE CHAIRMAN:

Q. Supposing we have a chat with you for a few minutes now?

DOCTOR EVIS (Secretary): Is he Mr. May's successor?

THE WITNESS: No, I do not think a successor has been chosen, but Mr. Scott was in that thing with the Bureau of Public Administration, and this particular publication (indicating) is his. I thought he would be helpful from the public-administration side of it.

Mr. May died just about ten days ago.

BY THE CHAIRMAN:

Q. Will you just give us an idea of what is going on here, Professor Tebbens?

A. Alright. In my capacity, in the technical side of it, I have one major research project underway. It is the research project of trying to define the characteristics of solid materials which come from combustion.

Now, "solid materials" sounds like "smog" basically. Then the question arises, "What is smog, and how is it formed?". This is the fundamental aspect of air pollution I am tackling.

We are finding some interesting chemicals in smog, which are not pure carbon. As a matter of fact, some of these chemical compounds are known to be cancer producing.

Q. You are finding them in the smog?

A. Yes, we are finding them in the smog. No matter how you make smog, whether from burning natural gas -- which is our fuel here -- or from a whole host of other matters, it is known to come from engine smoke and automobile smoke, and apparently it is more fundamental than just saying it is from automobiles or coal. It is the combustion where we get different kinds of chemicals, as by-products.

Q. I am glad you mentioned that, because our major problem is smoke as you can see it, and not so much the unseen air pollution. We have something which you can see and feel and which dirties clothing on the wash lines.

A. We are convinced now that when you make smog, you make some of the other chemical compounds which have been proven to be cancer producing when painted on

the skin of a mouse. That does not prove they have anything to do with humans, but it is interesting as a source of possible trouble.

BY MR. BELYEA:

Q. Do you consider there is any difference between smoke produced in the inside of a building, as against smoke which has been irradiated by the sunlight?

A. I took the smoke reading out of the smoke stack. The smoke is produced, and immediately sampled.

Q. The Pollution Department was doing a large amount of sampling, and the same thing out of doors?

A. Yes.

Q. And you would not be in a position to say whether there is any considerable difference between the cancer-producing properties of one, as against the other?

A. No, we are not attempting to do any biological work. We are not saying it is a cancer-producing chemical, but it is a chemical known to produce cancer in mice when painted on the skin.

Q. If the smoke has not been irradiated by sunlight, I think from industrial employees there should be a large number of statistics obtained which would

prove or disprove the higher incidence of cancer in these men, as against the ordinary men on the street?

A. There is some slight indication in recent studies by the State Laboratory here by Doctor Breslow, who has studied cancer as associated with occupations, and he found indications of an increase of the cancer rate in welders, and so on, and one other classification, that of marine firemen, and others who have been exposed to smoke in their work.

Q. Have they made a particular survey of these men, as against the states which have not the statistics?

A. They have not questioned the men themselves. They gather their information from questionnaires, as I understand it.

I cannot give you the details of how they did it, but several categories of occupations showed up as having some indication of cancer.

Q. I did see the X-ray slides of many thousands, and in various types of industry, and I know men who have had a great deal of experience have not seen any indication of it as yet.

A. It is a moot question.

Q. The rate is apparently so low, that if there is an increase, it is not too significant?

A. No.

BY MR. MURDOCH:

Q. We believe we are causing a great deal of damage to property through smoke and fly ash, and it has been indicated to us that if you could get a better combustion, you can sometimes get rid of the smoke and the ash, but you may produce something which is more dangerous to health than you had to begin with.

I think that is something which has to be given a great deal of consideration.

A. I think that has occurred in the more recent thinking in Los Angeles, that they were getting rid of a great deal of sulphur dioxide in the air, and now they are beginning to wonder if sulphur dioxide neutralizes some other things, and removing it might have been a harmful procedure.

I do not know that I subscribe to that, but I know I have heard it.

BY DOCTOR EVIS (Secretary):

Q. It is a very touchy thing to do. Do not take it out.

A. Yes, I know. This is one thing I have been

working on.

The second is to continue the sampling of smokiness that I am making on the roof of this building.

BY THE CHAIRMAN:

Q. Did you let some smoke out of this building a little while ago? We saw some good, dirty smoke coming out of this building.

A. It was not anything with which I had anything to do.

This has shown some rather interesting phenomena. This (indicating) is a year's sampling on the roof here, just taking in a two-hour sample of air, and passing it through filter paper, and it darkens the filter paper if there is smoke in the air.

In this (indicating) I brought all these results together, and if it was a single week, I added up the results of over-time periods by days of the week, and it shows an increasing smokiness every day up until about noon, including Sundays.

However, you will notice the Sunday level is away down, only about 60 percent. of the level of the other days of the week. However, it is not yet positive evidence of any particular source of smoke. They take what is going, on Sundays.

Industry, of course, is not going on Sundays, in our communities. Traffic is at its lowest level; people are burning the brush, and that is increased on Sundays, because the men are home, and are burning the brush.

I cannot make any positive statement that it is one thing or another. It has been found that Sundays are different from other days of the week.

The answer will have a great deal to do with where all this smoke comes from. One person says it is the dump; another says it is industry, while yet another says all the automobiles are doing it. I have never been able to say positively what the source of the trouble is. It is not of an irritant aspect. We get haze here on some days, and when we have haze, we get smoke.

BY DOCTOR EVIS (Secretary):

Q. This is the ceiling aspect?

A. Yes.

BY THE CHAIRMAN:

Q. Do any of your ladies do their washing on Sundays?

A. Yes; at least they hang the clothes out on Sundays.

We do not think our haze is as bad as in

a coal-burning area.

BY MR. BELYEA:

Q. You say it breaks by noon?

A. Just about noon every day, there is that break. Usually we get a west wind, and temperature inversion, so you may not burn one-quarter as much coal as some other persons. I think some inversions break about ten o'clock in the morning, so you might place it as much as they do.

Well, quantitatively, it is not too much. I have compared it with Pittsburg and Cincinnati with the same instrumentation.

We use very little solid fuel here commercially. The amount of coal burned around here is really negligible; it just is not used as commercial fuel.

We do have a good deal of oil burned.

BY MR. BELYEA:

Q. What is the method of sampling?

A. The A.I.S.I. sampler.

Q. Do you use the transmission light meter?

A. Yes.

Q. And it is the same method --

A. It is the Hemion method, of Pittsburgh.

Q. And you make comparisons on the same basis?

A. Yes.

BY MR. MURDOCH:

Q. What prompted these studies to be inaugurated? Was there any special reason, or any special demand for it? That is, the smoke and fly ash part of it, rather than the health aspect?

A. It is sort of self-generated, in a sense. To be enabled to secure some information, I had a graduate student check some outdoor samples, and we found very minute evidence of some of these organic compounds being present.

It seemed to be interesting enough for me to apply to the Public Health Service for some funds to look more into the question of combustion, and the Public Health Service saw fit to provide the funds.

That is the history of it.

We still do not know whether we are looking for a health problem; our basic interest is in the chemical and physical characteristic of these under combustion, and here is one aspect which may be very fundamental from a health standpoint.

Q. From a political viewpoint, has there been much demand on the part of the citizens for something to be done? Has there been a serious complaint about

the smoke or ash?

A. In this area?

Q. Yes.

A. You are probably aware that Los Angeles raised a great hue and cry.

Q. A hue and cry from a health standpoint rather than property damage?

A. Yes. In this area, we have a few days a year when there is similar eye irritation to that which has been noted in Los Angeles, and slowly, over a period of perhaps five or six years, people have become a little more concerned every time this phenomena occurs.

The outcry on the part of the public, as I see it, has not been a terribly strong outcry, but almost a voice in the wilderness.

Q. In Toronto, we had at one of our Committee meetings, three gentlemen who came to complain about the conditions under which they were living in their homes. They were speaking for all their neighbors who were complaining about the fumes and smoke ash from one particular plant.

Your situation is that people began to ask questions?

A. Yes. I think so, from what I have heard.

Of course, I do not have public contacts of the kind the Health Department has. I am in the University and we are teachers and researchers.

The local Health Department undoubtedly hears the points you bring up, because I am sure there are local complaints of conditions about some factory, or some dump that is burning, and so on. I have heard of those. They usually write to the Health Department.

BY MR. BELYEA:

Q. Do you know if anybody has made an estimate here of the property-damage costs per capita?

A. I do not know of any such estimate, no.

Q. There have been various estimates made, I know, in England and so on, but I doubt if there is any real work behind it.

A. It has to be a "guesstimate", so to speak.

I do not know of anybody in this community who has looked into that.

THE CHAIRMAN: My impression, when looking at the houses, is they are pretty clean as compared to many coal-burning communities.

BY MR. GORDON:

Q. That is, they keep clean longer?

A. Yes. They are fairly clean. I think that

is evidenced in more ways than by a chart.

BY MR. BELYEA:

Q. Yet you think it is important enough to make a study of it?

A. I think it is, because, to me, this whole question of the air-pollution problem on the West Coast -- whether it is eye irritation, haziness, loss of visibility and so forth -- is related to combustion somewhere.

In Los Angeles, their main point is that it is incomplete combustion of automobile fuels which is causing the eye irritation.

We see a little of that here, but much less than in the Los Angeles area.

I think combustion has a great deal to do with this loss of visibility we have on some days, and has some relation to the ceiling which may not be too bad.

I personally am of the view that combustion is the basis for much of the air pollution problem.

Q. Looking at this chart (indicating); it could not be the sea breezes?

A. I think it is due to some meteorological pattern.

Q. I suppose that breaks the temperature

inversion at the same time?

A. Yes, there is a tendency for everything to happen at once.

Q. I think that is interesting to everybody here, to see how the inversion can build this concentration and attain unusual levels.

A. Yes.

Q. The fact that it does drop down --

A. Rather precipitately, yes.

Q. Down to probably 50 percent. of the maximum?

A. Yes. This (indicating) is the average of the year's condition. It is not just a week or a couple of days; it is a whole year.

Of course, on a yearly basis, it is not for a Sunday or a Monday or any other day of the week. It is averaged out.

Q. I understand you have inversion on about 300 days of the year?

A. Something like that. It is very changeable. It is not always low down. It may be up several thousand feet.

Q. There are very few stations measuring it at night, and we do not know what we have.

A. I also take my class out to a first-class weather bureau station, and also the airport. They

take samples four times a day.

A. When we were down there last Saturday, they showed us an inversion of 500 or 600 feet thick. It was definitely there. We took a ride in the Goodyear Blimp, and we noticed how much warmer it was.

BY MR. MURDOCH:

Q. I was amazed at how many people were on the streets last night, and even after we went to bed, there were noises down below, and I could not see there was very much to it, because late at night and early in the morning is the time the air is clean.

A. Yes.

Q. Can you tell us what you found from some of the stations?

A. "Charlie" Gruber, in Cincinnati, took samples on a I.A.S.C. sampler, and he got higher samples at night, and as there was less industrial smoke at night time than in the day time, apparently he attributed it to the temperature inversion.

Here (indicating) is a summary of his stuff. It does not show as big a break, as my studies indicate.

Q. They have another aspect, and that is that the engineers in a plant blow their tubes at night, when nobody is looking.

A. There has been some complaint about the opening of the dump on the waterfront at Berkeley. When they light it, a column of smoke rises.

Q. Is that the daily garbage they are burning?

A. It is not garbage. It is combustible refuse. The people complain that they are burning it at night when people are not looking, and that is what they have been doing.

BY DOCTOR EVIS (Secretary):

Q. How long will it be before you publish your findings?

A. I have sent this in (indicating) for publication already, but I have no word of whether it will be published or not.

BY MR. BELYEA:

Q. Are you acquainted with other universities giving courses?

A. I know of some short courses.

Q. There was a Professor in one of the Districts in New York, gave a course, and I was wondering if there were any others.

A. An academic course, during a regular session?

Q. Yes, I believe at Berkeley.

A. I was not aware of their course, although I

have not followed it carefully. Ours may have been one of the first ones. We started in 1949.

Are you interested in a description of the course?

MR. BELYEA: Yes, that would be interesting.

THE CHAIRMAN: If there is nothing further, I think we will "shove off".

---Professor Tebbens retired.

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---Whereupon at 4:30 o'clock p.m., the further proceedings of this Committee adjourned until Tuesday, October 11th, 1955, at 9:15 o'clock, a.m.

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APPENDIX "A"

State Department of Public Health Analysis - AIR POLLUTION INVESTIGATION PROGRAM for Fiscal Year 1955-56

The attached budget for Air Pollution is intended to support an intensification of the work initiated by the Department during the current fiscal year with an allocation from the Governor's emergency fund.

In the preventive medical field this will include:

1. Analyses of mortality of populations exposed to air pollution to determine whether such pollution contributes to death. Particular attention will be given to infants and elderly people with diminished pulmonary function, e.g. patients in nursing homes.
2. Study of the sickness experience of populations exposed to air pollution through special surveys of the general population, schools and industrial groups, and admissions to hospitals.
3. Investigation of the effect of air pollution on the frequency and intensity of attacks of asthma, hay fever, and other respiratory illnesses.
4. Studies of the influence of air pollution on human performance - in school, at work, and on the athletic field.
5. Investigation of the effect of air pollution on other human functions, such as the respiratory and blood systems
6. Determination of the relationship of eye irritation to the daily and hourly variation in air pollutants in an effort to establish which pollutant or pollutants are

are responsible for this effect.

The above work will require close collaboration and some contractual arrangements with such organizations as hospitals, clinics, schools, and Bureau of the Census.

In the environmental field this will include:

1. Studies to further define the nature and mechanism of air pollution in California and develop a reliable index measurement or measurements.
2. Study of the nature and role of aerosols in air pollution.
3. Establishment of air monitoring networks in metropolitan areas and large isolated cities.
4. Assistance to local agencies in establishing continuing air pollution control programs.
5. Basic studies of major sources of air pollution in rural areas.
6. Special studies in field at times of unusual air pollution occurrence anywhere in the State.
7. Consultation and assistance to local agencies on specific air pollution problems.
8. Development of plan for coping with air pollution emergencies.
9. Regular program of disseminating information on air pollution to all parties and agencies.

The laboratory work and statistical operations will support the studies outlined above.

BUDGET FOR AIR POLLUTION INVESTIGATIONS

Other current expenses Budget Item 195

DIVISION OF ADMINISTRATION

Bureau of Business Management

Rent	\$4,500	
Office Equipment	<u>7,487</u>	
Total, Bureau of Business Management		\$11,987

Bureau of Health Education

Salaries and Wages		
Health Education Consultant \$458-556	\$5,496	
Less Estimated Salary Savings	<u>-550</u>	
Total Salaries and Wages	\$4,946	
Operating Expense	<u>2,500</u>	
Total, Bureau of Health Education		\$7,446

Bureau of Records and Statistics

Salaries and Wages		
2 Associate Public Health Analysts \$505-613	\$12,120	
1 Assistant Public Health Analyst 415-505	4,980	
1 Junior Public Health Analyst 341-415	4,092	
1 Accounting-Tabulating Machine Supervisor II 415-505	4,980	
1 Tabulating Machine Operator 268-325	3,216	
2 Intermediate Typist Clerks 231-281	<u>5,544</u>	

Total	\$34,932
Less Estimated Salary Savings	<u>-3,493</u>
Total Salaries and Wages	\$31,439
Operating Expense	
Tabulating Machine Rental	<u>\$1,200</u>

Total, Bureau of Records and Statistics \$32,639

DIVISION OF PREVENTIVE MEDICAL SERVICES

Bureau of Chronic Disease Control

Salaries and Wages

1 Public Health Medical Officer III	\$745-1050	\$8,940
1 Public Health Medical Officer II	676-950	8,112
1 Intermediate Stenographer-Clerk	243-295	<u>2,916</u>
Total		\$19,968

Less Estimated Salary Savings -1,997

Total Salaries and Wages \$17,971

Operating Expenses

Travel, printing, telephone, etc	3,000
Contractual Services	<u>55,000</u>
Total Operating Expenses	<u>\$58,000</u>

Total, Bureau of Chronic Disease Control \$75,971

DIVISION OF LABORATORIES

Salaries and Wages

1 Chief Research Chemist	\$613-745	\$7,356
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1 Research Chemist	\$505-613	\$6,060	
2 Assistant Public Health Chemists	415-505	9,960	
1 Intermediate Clerk	231-281	2,772	
1 Laboratory Assistant	231-281	<u>2,772</u>	
Total		\$28,920	
Less Estimated Salary Savings		<u>-2,968</u>	
Total Salaries and Wages		\$25,952	
Operating Expenses		5,500	
Equipment			
Technical		<u>35,000</u>	
Total, Division of Laboratories			\$66,452

DIVISION OF ENVIRONMENTAL SANITATION

Salaries and Wages

1 Chief, Bureau of Air Sanitation	\$745-905	\$8,940	
1 Senior Engineer	613-745	7,356	
2 Associate Engineers	505-613	12,120	
3 Assistant Engineers	415-505	14,940	
3 Intermediate Typist Clerks	231-295	<u>8,316</u>	
Total		\$51,672	
Less Estimated Salary Savings		<u>-5,167</u>	
Total Salaries and Wages		\$46,505	
Operating Expenses		<u>9,000</u>	
Total, Division of Environmental Sanitation			<u>\$55,505</u>
Total Budget for Air Pollution Investigations			\$250,000

APPENDIX "B"

STATE DEPARTMENT OF PUBLIC HEALTH

Proposed Air Pollution Investigation Program

Fiscal Year 1955-56

PREVENTIVE MEDICAL ASPECTS

The preventive medical program in the field of air pollution projected for the fiscal year 1955-56 would continue the surveillance of health effects from air pollution initiated during the present year. It will seek to determine and measure any adverse effects of health which result from atmosphere pollution such as those suggested by investigation during the past several months.

Project 1 Analyses of mortality of populations exposed to air pollution to determine whether such pollution contributes to death.

Particular attention will be given to infants and elderly people with diminished pulmonary function, e g , patients in nursing homes.

In the London, Donora (Pennsylvania) and other air pollution disasters, elderly persons with lung or heart disease were most seriously affected. California has suffered no such disaster to date and investigation thus far has revealed only very slim evidence of any fatal effect from air pollution in the state. However, it is important to ascertain whether such effects may be occurring.

A sizeable group (several thousands) of elderly persons with frail physique would be observed during a 6-12 month period to determine whether the mortality in the

group increased during periods of air pollution. The study group would be drawn from persons in nursing homes, old-age homes, and other institutions housing people 60-90 years of age who might be the first to manifest a fatal effect. A system would be established to provide daily mortality data for this population. Such data, when correlated with environmental measures of air pollution, would serve as a fairly sensitive indicator of air pollution as a factor in death.

Project 2. Study of the sickness experience of populations exposed to air pollution through special surveys of the general population, schools, industrial groups, and admissions to hospitals

Conceivably, air pollution may cause sickness or disability though not death. To ascertain whether such a morbid effect is occurring would require assembling a study group and establishing some system for recording the sickness experience on a daily or weekly basis. Such systematically recorded illness would then be studied in relation to episodes of air pollution as determined by environmental measures. A sample of the general population would be drawn by contracting with the U.S. Bureau of the Census in a manner similar to that of the California Health Survey which was utilized during the air pollution studies this past year. Study groups of school children, industrial employees and possibly other groups would be assembled by arrangement with school administrations and industrial plants. This survei-

llance of the health effects would, of course, take advantage of present systems for recording the sickness experience of the groups being observed, e g , school and industrial medical and nursing records

Project 3 Investigation of the effect of air pollution on the frequency and intensity of attacks of asthma, hay fever, and other respiratory illnesses

Los Angeles physicians have reported the clinical impression that patients with asthma and other respiratory diseases suffer an increased number of attacks during periods of air pollution. However, this remains a mere impression. No actual data have been found to substantiate it.

Again, as in the case of proposed mortality and general morbidity studies special populations would be assembled for observation. Selected physicians would be asked to cooperate by maintaining a systematic record of the attacks of illness among a pre-selected sample of patients with asthma and other conditions that might be affected by air pollution. In addition, persons with emphysema might be selected from among an older age group by use of the chest x-ray and observed to determine whether or not episodes of illness coincided with periods of air pollution.

Project 4. Studies of the influence of air pollution on human performance -- in school, at work and on the athletic field.

Air pollution may adversely affect human performance, physical and mental, even though it causes no recognizable

illness or mortality. In fact, some evidence suggesting this came from a survey of Los Angeles school children this past year.

It is proposed that a definite sample of school children, who are exposed to air pollution when it occurs, would be subjected to periodic physical and mental tests during the air pollution "season". Tests might cover athletic abilities of various types as well as intellectual performance on arithmetic problems and the like. Analysis of performance in relation to periods of air pollution would indicate whether or not a detrimental effect is occurring. Similar studies could be undertaken for occupational performance.

ENVIRONMENTAL ASPECTS

In general, the environmental program planned for the fiscal year 1955-56 is investigatory rather than research in nature. That is, it will be directed toward a study of what conditions actually occur in the atmosphere as determined by field measurements and their analysis and interpretation. Laboratory work planned will relate to the validation and use of analytical methods for measuring air pollutants and equipment, particularly automatic equipment for collecting and recording the presence of air pollutants.

Project 5. Studies to further define the nature and mechanism of air pollution in California and to develop a reliable index measurement or measurements

If air pollution control is to be put on a sound

engineering basis, four things must be known with reasonable precision:

- a. The identity of the substances in the atmosphere which are causing the trouble;
- b. The maximum and mean intensity of these substances at critical times and places;
- c. The location and magnitude of the sources of emission of these substances, or their ingredients, into the atmosphere;
- d. The manner in which these substances become distributed through the atmosphere with consequent dilution

If these things are known, it is possible to actually design with assurance either a corrective program in an area like Los Angeles or a preventive program in an area such as the San Francisco Bay. Without such knowledge, one can only proceed by trial and error basing his actions at best upon intelligent guesswork.

The carrying out of this project will comprise, first, collection and careful analysis of available existing information and, second, the development of programs of data collection to fill in the gaps utilizing locally available resources to the maximum degree.

Included in this project is the development of a system of measurements which, when taken together, will furnish an index or yardstick of urban air pollution which may be used

as a practical and inexpensive means of monitoring an urban area. A complete and continuous record of quality of the atmosphere is a prime requisite, in medical and biological studies, on the effects of air pollution as well as being indispensable in the planning and execution of environmental programs.

Project 6. Study of the nature and role of aerosols in air pollution.

From both a physical standpoint (visibility) and a physiological standpoint (eye and respiratory irritation), the physical form in which an air pollutant occurs is likely to prove a matter of the highest importance. The detrimental effects of a given quantity of air pollutants in gaseous form may be many fold increased when the same quantity of the same pollutants are in the form of solid particles or liquid droplets. Furthermore, the size, shape, surface area of the particles may be of equally great significance. These factors are so important that they may furnish the explanation for many of the apparent inconsistencies in past information and yet relatively little attention has been given to them to date. This project would consist of seeing that information on physical form (aerosol phase) be incorporated into all measurements of the chemical quality of the atmosphere and would embody the validation of methods suitable for field use.

Project 7. Establishment of air monitoring networks in metropolitan areas and large isolated cities.

In only two areas of the state (Los Angeles County and San Francisco Bay) has anything approaching an organized program for the regular measurement of air quality been inaugurated, and yet this is the only way that one can begin to understand the current severity of the problem, and what is even more important, the rate of change from week to week and year to year. It is undisputed that an abatement program is many times more costly than a preventive program, and yet it is impossible to inaugurate a preventive program in time if we wait until the air pollution condition has forced itself to the attention of the public.

It is planned under this project to secure the coverage of the three metropolitan areas of the state with monitoring networks of stations and each large isolated city of 50,000 population or more with at least one monitoring station. Daily monitoring at such stations would utilize index measurements and equipment developed or improved under Projects 1 and 2 above. Maximum possible use of local resources would be made. In areas having a legally established air pollution control agency, that agency would be expected to carry out the bulk of the operation and bear the major cost of equipment needed. State level activities would, therefore, serve largely to get the programs under way by actual demonstration.

Project 8. Assistance to local agencies in establishing continuing air pollution control programs.

The state's activity under this project would be in

many respects similar to present activities in the Bureau of Sanitary Engineering in the development of community sewerage programs. State engineers work closely over a period of time with local governing bodies, and city and county officials, to assist them in understanding the technical aspects of the problem and developing a plan of action which is sound from scientific, administrative, and financial points of view. Where action or support by the general public is needed, the state's help is indispensable in giving the voters the assurance that full advantage is taken of experience on similar problems elsewhere in the state.

In this project, following such consultative assistance in the developmental stages, the state will render technical support and advice to control programs, particularly during the first critical years of operation.

Project 9. Basic studies of major sources of air pollution in rural areas.

The initial report of the department on air pollution in California stressed the fact that certain special types of air pollution of industrial, commercial, or agricultural origin cause serious detrimental effects over extensive rural areas. Examples are sawdust burners and road mix plants. The normal process of solving these admittedly localized problems by leaving this solution entirely up to industrial, agricultural or local governmental initiative has in these cases proven either too ineffective or too slow, and large numbers of people suffering from these types

of air pollution now look to the state for relief.

This project proposes that the state study these problems and particularly the processes or practices causing them and make known both to the industry in question and local government the most logical solution in the public interest. Since these problems repeat themselves many times and frequently move from one area to another, one fundamental study of each will serve many localities and be far more economical than studies by each locality in which the problem occurs.

Project 10. Special studies in field at times of unusual air pollution occurrence anywhere in state.

Unusual or abnormal episodes of air pollution furnish one of the best opportunities to acquire reliable information on many important aspects of the nature, cause, effects, distribution, etc. of air pollutants. One reason is that at times of such episodes, it is possible to relate cause and effect more reliably than in the study of areas where air pollution is chronic because the changes that brought on the episode are easily noted.

Consequently, this project calls for the state to be prepared with mobile field laboratory facilities to move quickly into any area and carry on intensive measurements of the quality of the atmosphere on a continuous basis over a number of locations. Simultaneously, studies would be made of unusual emissions to the air and of pertinent meteorological data. Not only would this environmental

information be of value in its own right, but it would be available for correlation with the medical findings on the same episode.

Project 11. Consultation and assistance to local agencies on specific air pollution problems.

Long before organized air pollution control programs are established in an area, there is a continuing demand for assistance on specific air pollution problems where a specific operation, industrial or commercial, is causing nuisance and property damage to a "downwind" area. The department has rendered technical assistance on this type of problem for many years, and the purpose of this project is to centralize this type of service and make it more efficient. In the past, only a token amount of technical assistance could be given and consequently the record of successful abatement of these types of public nuisance has not been good.

Project 12. Development of a plan for coping with air pollution emergencies.

Past experiences elsewhere have shown that air pollution could reach disaster levels. It is essential, therefore, that each local agency establish a plan of action to cope with air pollution emergencies. The state unit will provide technical and material assistance in establishing such plans and providing the required statewide coordination. Included in this activity would be long-term studies to determine the rate of build-up of contaminants and its relation to

abnormal meteorological conditions. On the basis of these environmental findings and available knowledge of toxic levels of contaminants, it may be possible by statistical predictors to anticipate disaster producing levels of air pollution situations which may have reached emergency proportions.

Project 13. Regular program of dissemination of information on air pollution to all parties and agencies.

The State Department of Public Health is the logical choice for the performance of the following functions of general interest to all local air pollution agencies:

- a. Maintain a pipeline of communication between local air pollution units. The latest information on the engineering, chemical, legislative, and other aspects of air pollution would be collected from various local, national, and international sources and in turn be disseminated through the state in the form of periodic reports, seminars, short courses jointly conducted with the university.
- b. Maintain a system whereby smaller air pollution agencies would feed environmental data of regional interest into one central unit for analysis, interpretation, and general reporting.
- c. Maintain a central clearing house; this could be set up for meteorological and climatological data on a regional basis to fill the need of atmospheric basins without needless duplication of effort.

APPENDIX "C"

Senate Bill No. 127

CHAPTER 1312

An act to add Article 9 to Chapter 2, Part 1, Division 1 of the Health and Safety Code, relating to air sanitation.

(Approved by Governor June 24, 1955.
Filed with Secretary of State June
27, 1955)

The people of the State of California do enact as follows:

SECTION 1. Article 9 is added to Chapter 2, Part 1, Division 1 of the Health and Safety Code, to read:

ARTICLE 9. AIR SANITATION

425. The State Department of Public Health shall maintain a program of air sanitation, including, but not limited to:

- (a) The conduct of studies to determine the health effects of air pollution;
- (b) The determination of the physiological effects of air pollution upon plant and animal life;
- (c) The determination of factors responsible for air pollution;
- (d) The monitoring of air pollutants;
- (e) The development of administrative means of control of air pollution in emergencies;
- (f) Assistance to local agencies in effectuating all of the subdivisions of this section.

426. The department may enter into agreements with any public or private organization, agency, or individual to carry out its duties and responsibilities with respect to air sanitation.

APPENDIX "D"

Assembly Bill No 3545

CHAPTER 1797

An act to add Chapter 2.5 to Division 20 of, and to add Sections 24213 and 24214 to the Health and Safety Code, creating the Bay Area Air Pollution Control District, setting forth its organization, powers, and duties, all relating to the control of air pollution.

(Approved by Governor July 7, 1955. Filed with Secretary of State July 8, 1955)

The People of the State of California do enact as follows:

SECTION 1. Chapter 2.5 is added to the Health and Safety Code to read:

Chapter 2.5 BAY AREA AIR POLLUTION CONTROL DISTRICT

ARTICLE 1. SHORT TITLE'

24345. This chapter may be cited and shall be known as the Bay Area Air Pollution Control Law.

ARTICLE 2. DECLARATION OF POLICY

24346. The Legislature finds and declares that the people of the State of California have a primary interest in atmospheric purity and freedom of the air from any air contamination and that there is pollution of the atmosphere in certain portions of the State which is detrimental to the public peace, health, safety, and welfare of the people of the State.

24346.1. The Legislature further finds and declares:

(a) That in portions of the State the air is polluted with smoke, charred paper, dust, soot, grime, carbon, noxious acids, fumes, gases, odors, particulate matter, and other air contaminants.

(b) That it is not practical or feasible to prevent or reduce such air contaminants by local county and city ordinance.

(c) That it is necessary, therefore, to provide for air pollution control districts in those portions of the State where regulations are necessary and feasible to reduce air contaminants in order to safeguard life, health, property and the public welfare and to make possible the comfortable enjoyment of life and property.

24346.2. The problems of air pollution are primarily regional and dependent upon factors of weather, topography, population, transportation, methods of waste disposal, and agricultural and industrial development. These factors vary greatly from area to area. The San Francisco Bay area, with its permanent temperature inversion layer, presents a special problem, distinct from that found in the remainder of the State. This chapter is enacted to provide a special district to control and suppress air pollution in that area.

Since the problem requiring this legislation is local and special due to atmospheric and geographic conditions, a general law cannot be made applicable so as to insure its effective alleviation. It is necessary, therefore, to create, by special law, an air pollution control district which includes only that area within the boundaries of the Counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

ARTICLE 3. DEFINITIONS

24348. "District" as used in this chapter, means the

Bay Area Air Pollution Control District.

24348.1. "Board" as used in this chapter, means the board of directors of the district.

24348.2. "Control Officer" as used in this chapter, means the air pollution control officer of the district.

24348.3. "Air Contaminant", as used in this chapter, includes smoke, charred paper, dust, soot, grime, carbon, noxious acids, fumes, gases, mist, odors, or particulate matter, or any combination thereof

ARTICLE 4. CREATION OF DISTRICT

24350. An air pollution control district is hereby created comprising the area lying within the boundaries of the Counties of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma, which shall be called the Bay Area Air Pollution Control District.

24350.1 The district is a body corporate and politic and a public agency of the State.

24350.2. On the effective date of this chapter, the district shall begin to transact business and exercise its powers under this chapter in the Counties of Alameda, Contra Costa, Marin, San Francisco, San Mateo, and Santa Clara.

24350.3. The district shall not transact any business or exercise any of its powers under any of this chapter in the Counties of Napa, Solano, and Sonoma until and unless the boards of supervisors of such counties determine in the manner provided by this article that there is need for the district to function in such counties and so declare by resolution.

24350.4. Before the district may begin to transact business or exercise its powers in Napa County, Solano County, or Sonoma County, the board of supervisors of such county, on its own motion or whenever a petition requesting that the district transact business and exercise its powers in such county signed by not less than 10 percent of the qualified electors of such county is presented to such board of supervisors, shall hold a public hearing to determine whether or not there is need for the district to function in such county.

24350.5. Prior to the public hearing, the board of supervisors shall give notice of the time and place of hearing by publication once in a newspaper of general circulation not less than 15 days nor more than 45 days before such hearing.

24350.6. Upon conclusion of the public hearing the board of supervisors may adopt a resolution declaring that there is need for the district to function in such county if from the evidence received at such hearing it finds that it is in the best interests of such county that the district function therein.

24350.7. Upon adoption of the resolution the board of supervisors of such county shall cause a certified copy of it to be filed with the board.

24350.8. From and after the date of the filing of the certified copy of the resolution with the board, the district shall begin to function and may exercise its powers within such county.

24351. There shall be a separate and distinct city selection committee for each county in which the district may transact business and exercise its powers. The membership of such committees shall consist of the mayor of each city within such county, or, where there is no mayor, the chairman or the president of the city council.

24351.1. A majority of the members of each city selection committee shall constitute a quorum.

24351.2. The City and County of San Francisco is a city for purposes of this article.

24351.3. The city selection committee of each county shall meet on October 28, 1955, at 10 a.m. in the chambers of the board of supervisors of such county for the purpose of making the first appointment to the district board as prescribed in Section 24352. The committee of each county shall thereafter meet on the second Monday in May of each even-numbered year, at 10 a.m. in the chambers of the board of supervisors of such county, for the purpose of making succeeding appointments to the district board as prescribed in Section 24352.1. At least two weeks prior to the date of each meeting the county clerk of each county shall give notice of such meeting to each member of the city selection committee of such county. The meeting of the city selection committee of each county shall be conducted in the presence of the county clerk of such county who shall act as the recording officer for the meeting. It shall be the duty of the county clerk to notify in writing the board of super-

visors of such county and also the clerk of the district board of the appointment made by the city selection committee within 10 days after such appointment has been made.

24351.4. Each committee shall appoint a chairman from among its members and such other officers as may be necessary.

24351.5. Members of the committees shall serve without compensation, but may be allowed actual expenses incurred in the discharge of their duties.

ARTICLE 5. GOVERNING BODY

24352. The governing body of the district is a board of directors who shall be selected as provided in this article.

On or before October 28, 1955, the board of supervisors of each county in which the district may at that time transact business and exercise its powers shall appoint one of its members to be a member of the board. If the district may not transact business or exercise its powers in any county within the district on October 28, 1955 the board of supervisors of such county shall appoint one of its members to be a member of the board within 30 days after the district may so function within such county.

On October 28, 1955, the city selection committee of each county shall appoint one member of the board. Such member shall be selected from among the mayors and city councilmen of the cities within such county. If the district may not transact business or exercise its powers in any county within the district on October 28, 1955, the city selection

committee shall so appoint such member of the board within 30 days after the district may so function within such county.

24352.1. Each member of the first board shall hold office until June 1, 1956, and thereafter each member appointed by the board of supervisors shall hold office for a term of four years and until the appointment and qualification of his successor and each member appointed by the city selection committee shall hold office for two years and until the appointment and qualification of his successor. Any vacancy on the board shall be filled by appointment in the same manner as the vacating member was appointed. Any member of the board may be removed at any time in the same manner as he was appointed; provided, however, that if four-fifths of the members of the board of supervisors of a county request the removal of a member appointed by the city selection committee of such county, the city selection committee of such county shall meet within 20 days to consider the removal of such member.

24352.2. Any member of the board may be recalled from his office of member of the board of supervisors or of mayor or member of the legislative body of a city pursuant to Division 13 of the Elections Code, in which event his office as member of the board shall be vacant.

24352.3. The board is the governing body of the district and shall exercise all the powers of the district,

except as otherwise provided.

24352.4 A majority of the members of the board constitutes a quorum for the transaction of business and may act for the board

24352.5 Each member of the board shall receive the actual and necessary expenses incurred by him in the performance of his duties, plus a compensation of twenty-five dollars (\$25) for each day attending the meetings of the board, but such compensation shall not exceed four hundred dollars (\$400) in any one year.

24352.6 The board may appoint an executive secretary to perform such duties as may be assigned to him by the board

24352.7 The board may cooperate and contract with any federal, state, or local governmental agencies, private industries, or civic groups necessary or proper to the accomplishment of the purposes of this chapter

ARTICLE 6. POWERS AND DUTIES

24354. The district shall have power:

- (a) To have perpetual succession
- (b) To sue and be sued in the name of the district in all actions and proceedings in all courts and tribunals of competent jurisdiction
- (c) To adopt a seal and alter it at its pleasure.
- (d) To take by grant, purchase, gift, devise, or lease, hold, use, enjoy, and to lease or dispose of real or personal property of every kind within or without the district

necessary to the full exercise of its powers.

(e) To lease, sell or dispose of any property or any interest therein whenever in the judgment of the board such property, or any interest therein, or part thereof, is no longer required for the purposes of the district, or may be leased for any purpose without interfering with the use of the same for the purposes of the district, and to pay any compensation received therefor into the general fund of the district

24354.1 The district shall establish and execute an effective program for the reduction of air contaminants within the district

24354 2. The district shall do such acts as may be necessary to carry out the provisions of this chapter

24354 3. The board shall establish and maintain such offices wherever it deems will best facilitate the accomplishment of the district objectives.

24354.4 The board shall meet at such times and places as decided by the board

24354.5 The board shall appoint a chairman from its members and such other officers as may be necessary

24354 6 The board shall determine the compensation of, and pay from district funds, the control officer, all of his personnel, the executive secretary, and members of the hearing board

24354.7 The board shall provide for the number of personnel to be employed by the control officer and for their duties and the times at which they shall be appointed.

24354.8 The board may contract with any city or county, any state department, or any competent person or agency for the conducting of competitive examinations to ascertain the fitness of applicants for employment and for the performance of any other service in connection with administration of the district

24354.9 The board may by ordinance adopt a civil service system for any or all employees of the district, except that the executive secretary and air pollution control officer shall be exempt from such system and shall serve at the pleasure of the board

24354.10 In exercising its powers and duties, the district shall, whenever feasible, secure necessary technical, administrative and operational services by contract with public agencies to the end that duplication of similar services and facilities is avoided to the extent possible. This section shall not be construed as requiring the board to contract for services which the board determines should, in the best interests of the district, be provided by the district or services which can be provided by the district at a lesser cost than by contract.

, ARTICLE 7. AIR POLLUTION CONTROL
 OFFICER

24355. The board shall appoint an air pollution control officer

24355.1 Subject to the provisions of Article 6, the control officer shall appoint his personnel

24355 2. The control officer shall observe and enforce:

- (a) The provisions of this act
- (b) All orders, regulations, and rules prescribed by the board.
- (c) All variances and standards which the hearing board has prescribed

ARTICLE 8. ADVISORY COUNCIL

24356. The board shall appoint a Bay Area Air Pollution Control Advisory Council to advise and consult with the board and the control officer in effectuating the purposes of this chapter. The council shall consist of the chairman of the board, who shall serve as an ex officio member, and 20 members who preferably are skilled and experienced in the field of air pollution, including at least one representative of colleges or universities in the State and at least one representative of each of the following groups within the district, health agencies, agriculture, industry, community planning, transportation, registered professional engineers, general contractors, architects, and organized labor

24356.1 The council shall select a chairman and vice chairman and such other officers as it deems necessary.

24356.2. Council members shall serve without compensation but may be allowed actual expenses incurred in the discharge of their duties. The council shall meet as frequently as the directors or the council deem necessary

ARTICLE 9 HEARING BOARD

24357. Within 30 days after the district, by resolution, determines it necessary to adopt rules and regulations to control the release of air contaminants, the district board shall appoint a hearing board, to consist of three members, none of whom is otherwise employed by the district. One member shall have been admitted to practice law in this State. One member shall be a chemical or mechanical engineer.

24357.1. The district board shall appoint one member of the hearing board for a term of one year, one for a term of two years, and one for a term of three years. Thereafter the terms of members of the hearing board shall be three years.

ARTICLE 10. ENFORCEMENT

24360. A person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public or which endanger the comfort, repose, health or safety of any such persons or the public or which cause or have a natural tendency to cause injury or damage to business or property.

24360.1. This article does not apply to smoke from fire set by or permitted by any public officer if such fire is set or permission given in the performance of the official duty of such officer, for the purpose of weed

abatement, the prevention of a fire hazard, or the instruction of public employees in the methods of fighting fire, which is, in the opinion of such officer, necessary

24360.2 This article does not apply to smoke from agricultural fires set by, or permitted by, the county agricultural commissioner of any county within the district after consultation with the board, if such fire is set or permission given in the performance of the official duty of such county agricultural commissioner for the purpose of disease prevention.

24360.3. The Legislature does not, by the provisions of this chapter, intend to occupy the field.

The provisions of this chapter do not prohibit the enactment or enforcement by any county or city of any local ordinance stricter than the provisions of this article and stricter than the rules and regulations adopted pursuant to this chapter, which local ordinance prohibits, regulates or controls air pollution

24360.4 The provisions of this chapter do not supersede any such local county or city ordinance.

24360.5. If it should be held that the provisions of this chapter supersede the provisions of any local county or city ordinance, such suspension shall not bar the prosecution or punishment of any violation of such ordinance which violation was committed when such ordinance was in full force and effect

24360 6. Nothing in this article limits in any way the

the power of the board to make needful orders, rules, and regulations pursuant to other provisions of this chapter. Nothing in this article permits any action contrary to any such order, rule, or regulation.

24360.7. Any violation of any provisions of this article or of any order, rule, or regulation of the board may be enjoined in a civil action brought in the name of the people of the State of California.

ARTICLE 11. RULES AND REGULATIONS

24362. At any time after October 1, 1956, the board may by resolution declare it necessary that the district adopt rules and regulations to control the release of air contaminants in order to reduce or alleviate air pollution within the district. Such determination shall be based on surveys and studies made by the district and such other information as may be available to the district. The determination shall be made only after the board has considered the matter at a public hearing at which all interested persons are afforded the opportunity to appear and urge or oppose adoption of the resolution. The board shall give notice of its intention to adopt the resolution and give notice of the hearing by publication in a newspaper of general circulation in each of the counties within the district not less than 10 days prior to the hearing. The notice shall contain the time and place of the hearing and such other information as may be necessary to reasonably apprise the people within the district of

the nature and purpose of the meeting. The hearing may be adjourned from time to time in order to permit presentation of all pertinent testimony.

Upon the conclusion of the hearing, if the board determines it to be necessary to adopt rules and regulations to control the release of air contaminants, the board shall so declare by resolution.

24362.1. At any time after the resolution of necessity has been adopted, the board may make and enforce all needful orders, rules and regulations necessary or proper to accomplish the purposes of this chapter

24362.2. The board shall not enact any order, rule or regulation until it first holds a public hearing thereon. It shall give not less than 10 days notice of the time and place of such public hearing by publication in a newspaper of general circulation published within the district

24362.3. Whenever the board finds that the air in the district is so polluted as to cause discomfort or property damage at intervals to a substantial number of inhabitants of the district, the board may make and enforce such general orders, rules, and regulations as will reduce the amount of air contaminants released within the district, but no order, rule or regulation of the board shall specify the design of equipment, type of construction, or particular method to be used in reducing the release of air contaminants

24362.4. The control officer at any time may require from

any person subject to regulations of the board, such information or analyses as will disclose the nature, extent, quantity, or degree of air contaminants which are or may be discharged by such source, and may require that such disclosures be certified by a professional engineer registered in the State. In addition to such report, the control officer may designate and employ a registered professional engineer of his choice to make an independent study and report as to the nature, extent, quantity, and degree of any air contaminants which are or may be discharged from the source. An engineer so designated is authorized to inspect any article, machine, equipment or other contrivance necessary to make the inspection and report.

24362.5. If any person within a reasonable time willfully fails or refuses to furnish to the control officer information or analyses requested by such control officer, or if the control officer finds that any order, rule or regulation of the board is being violated after a reasonable time has been allowed for compliance, the control officer shall notify the hearing board of such facts and request a public hearing on the matter.

24362.6. Within 30 days after the control officer has requested a public hearing, the hearing board shall hold such a hearing and give notice of the time and place of such hearing to the person cited, to the control officer and to such other persons as the hearing board deems

should be notified, not less than 10 days before the date of the public hearing.

24362 7 After a public hearing, the hearing board may find that no violation exists, or may take any of the actions provided in Article 12 and Article 13 of this chapter

ARTICLE 12. VARIANCES

24365. The provisions of this chapter do not prohibit the discharge of air contaminants to a greater extent or for a longer time, or both, than permitted by Article 10 or by rules, regulations, or orders of the board, if not of a greater extent or longer time than the hearing board or a court after a hearing before the hearing board finds necessary pursuant to the provisions of this article.

24365.1 The hearing board on its own motion or at the request of any person may hold a hearing to determine under what conditions and to what extent a variance from the requirements established by Article 10 or by rules, regulations, or orders of the board is necessary and will be permitted.

24365.2. The board may provide, by regulation, a schedule of fees which will yield a sum not exceeding the estimated cost of the administration of this article, for the filing of applications for variances or to revoke or modify variances. All applicants shall pay the fees required by such regulations.

24365.3 All such fees shall be paid to the district treasurer to the credit of the district

24365.4. The hearing board shall serve a notice of the time and place of a hearing to grant a variance upon the control officer and upon the applicant, if any, not less than 10 days prior to such hearing.

24365.5. If the hearing board finds that because of conditions beyond control compliance with Article 10 or with any rule, regulation, or order of the air pollution control board will result in an arbitrary and unreasonable taking of property or in the practical closing and elimination of any lawful business, occupation or activity, in either case without a sufficient corresponding benefit or advantage to the people in the reduction of air contamination, it shall prescribe other and different requirements not more onerous applicable to plants and equipment operated either by named classes of industries or persons, or to the operation of separate persons; provided, however, that no variance may permit or authorize the maintenance of a nuisance.

24365.6. In determining under what conditions and to what extent a variance from said requirements is necessary and will be permitted, the hearing board shall exercise a wide discretion in weighing the equities involved and the advantages and disadvantages to the residents of the district and to any lawful business, occupation or activity involved, resulting from requiring compliance

with said requirements or resulting from granting a variance.

24365.7. The hearing board may revoke or modify by written order, after a public hearing held upon not less than 10 days' notice, any order permitting a variance.

24365.8. The hearing board shall serve notice of the time and place of a hearing to revoke or modify any order permitting a variance not less than 10 days prior to such hearing upon the control officer, upon all persons who will be subjected to greater restrictions if such order is revoked or modified as proposed and upon all other persons interested or likely to be affected who have filed with the hearing board or control officer a written request for such notification.

24365.9. The hearing board shall serve a notice of the time and place of a hearing to grant a variance or to revoke or modify an order permitting a variance either by personal service or by first-class mail, postage prepaid. If either the identity or address of any person entitled to notice is unknown, the hearing board shall serve such person by publication of notice once in a newspaper of general circulation published within the district.

24365.10. The hearing board in making any order permitting a variance may specify the time during which such order will be effective, in no event to exceed one year, but such variance may be continued from year to year without another hearing on the approval of the control officer.

24365.11 If any local county or city ordinance has provided regulations similar to those in Article 10 or to any order, regulation, or rule prescribed by the board, and has provided for the granting of variances, and pursuant to such local ordinance a variance has been granted prior to notification of the district, such variance shall be continued as a variance of the hearing board for the time specified therein or one year, whichever is shorter, or until and unless prior to the expiration of such time the hearing board modifies or revokes such variance as provided in this article

ARTICLE 13. PROCEDURE

24367 This article applies to all hearings which either Article 11 or Article 12 of this chapter provides shall be held by the hearing board.

24367.1. The hearing board shall select from its number a chairman.

24367.2 The hearing board may hold a hearing in bank or may designate two or one of their number to hold a hearing.

24367.3 If two or three members of the hearing board conduct a hearing the concurrence of two shall be necessary to a decision

24367.4. The hearing board, not less than two being present, may, in its discretion, within 30 days rehear any matter which was decided by a single member.

24367.5. Whenever the members of the hearing board conducting any hearing deem it necessary to examine any person as a witness at such hearing, the chairman of the hearing board shall issue a subpoena, in proper form, commanding such person to appear before it at a time and place specified to be examined as a witness. The subpoena may require such person to produce all books, papers, and documents in his possession or under his control material to such hearing.

24367.6. A subpoena to appear before the hearing board shall be served in the same manner as a subpoena in a civil action

24367 7. Whenever any person duly subpoenaed to appear and give evidence or to produce any books and papers before the hearing board neglects or refuses to appear, or to produce any books and papers, as required by the subpoena, or refuses to testify or to answer any question which the hearing board decides is proper and pertinent, he shall be deemed in contempt, and the hearing board shall report the fact to the judge of the superior court of the county in which the person resides.

24367.8 Upon receipt of the report, the judge of the superior court shall issue an attachment directed to the sheriff of the county where the witness was required to appear and testify, commanding the sheriff to attach such person and forthwith bring him before the judge who ordered the attachment issued.

24367.9. On the return of the attachment and the production of the body of the defendant, the judge has jurisdiction of the matter. The person charged may purge himself of the contempt in the same way, and the same proceeding shall be had, and the same penalties may be imposed, and the same punishment inflicted as in the case of a witness subpoenaed to appear and give evidence on the trial of a civil cause before a superior court.

24367.10 Every member of the hearing board may administer oaths in every hearing in which he participates, and at any hearing the hearing board may require all or any witnesses to be sworn before testifying.

24367.11 Whenever the hearing board finds that any person is in violation of any order, rule or regulation of the board, and that no variance is justified, and that reasonable time has been allowed for compliance, the hearing board shall certify such facts to the district attorney for the county in which the discharge originates whereupon such district attorney shall petition the superior court in and for the county for the issuance of an injunction restraining such person or persons from continuing any activity causing or threatening a pollution or nuisance. The court shall thereupon issue an order directing the person to appear before the court and show cause why the injunction should not be issued. Thereafter the court shall have jurisdiction of the matter, and proceedings thereon shall be conducted in the same manner as in any

other action brought for an injunction. The court shall receive in evidence any order, rule or regulation of the board, any transcript of the proceedings before the hearing board, and such further evidence as the court in its discretion deems proper.

24367.12. Any person deeming himself aggrieved, including the district, may maintain a special proceeding in a superior court within the district, to determine the reasonableness and legality of any action of the hearing board.

24367.13. Any person filing such a special proceeding after any decision of the hearing board shall be entitled to a trial de novo and an independent determination of the reasonableness and legality of such action in such court on all issues of law, facts, and mixed questions of law and facts and opinions therein involved.

ARTICLE 14. FINANCIAL PROVISIONS

24370. The district may borrow money and incur indebtedness in anticipation of the revenue for the current year in which the indebtedness is incurred or of the ensuing year. Such indebtedness shall not exceed the total amount of the estimate of the tax income for either the current year or the ensuing year

24370.1. Before the fifteenth day of June of each year the board shall estimate and determine the amount of money required by the district for purposes of the district

during the ensuing fiscal year and shall apportion this amount to the counties included within the district, one-half according to the relative value of the real estate of each county within the district as determined by the board and one-half in the proportion that the population of each county bears to the total population of the district. For the purposes of this section the board shall base its determination of the population of the several counties on the latest official information available to it. The total amount of money required by the district for district purposes during any one fiscal year shall not exceed one cent (\$.01) on each one hundred dollars (\$100) of the assessed valuation of all the property included within the district.

24370.2 On or before the fifteenth day of June of each year, the board shall inform the boards of supervisors of each county of the amount apportioned to the county. Each board of supervisors shall levy an ad valorem tax on the taxable real property within the county included within the district sufficient to secure the amount so apportioned to it and such taxes shall be levied and collected together with, and not separately from, the taxes for county purposes and paid to the treasurer of each of the counties to the credit of the district.

24370.3. Taxes levied by the board of supervisors for the benefit of the district shall be a lien upon all property within such county lying within the district and

shall have the same force and effect as other liens for taxes. Their collection may be enforced in the same manner as liens for county taxes are enforced.

24370.4. At any time prior to the first receipt by the district of revenues from taxation, the counties within the district may loan any available money to the district for purposes of organization and operation and such expenditures shall constitute a proper expenditure of county funds. The board shall add the sums of money so borrowed from the counties to the first amount apportioned by the board pursuant to Section 24370.1, and shall repay the counties for all money borrowed from the first revenues received from taxation.

24370.5. The treasurers of the several counties within the district shall pay into the district treasury all funds held by them to the credit of the district.

24370.6. The district treasury shall be in the custody of the county treasurer of a county in the district designated by the board and such treasurer shall be the district treasurer.

24370.7 The district board shall, in carrying out the provisions of this article, comply as nearly as possible with the provisions of Chapter 1 of Division 3 of Title 3 of the Government Code.

ARTICLE 15 DISSOLUTION

24372. A district may be dissolved in the following

manner:

1. The boards of supervisors of the counties containing more than fifty percent (50%) of the population of the entire district shall adopt a resolution stating that the existence of the district is no longer necessary or desirable for the public welfare, and announcing the intention to withdraw therefrom and to dissolve the district.

2. The resolutions so adopted shall be communicated to the clerks of the boards of supervisors of all counties comprising the district and also to the board.

3. If it appears that the resolutions were adopted by the boards of supervisors in the counties desiring to withdraw, and that such counties contain more than fifty percent (50%) of the entire population in the district, the board, by resolution, shall call an election to determine the question of dissolution. The resolution shall state the time and place and purpose thereof, establish election precincts, designate polling places, and appoint election officers and, in all respects not provided in this section, the election shall be held and conducted, as nearly as practicable, in the same manner as elections for county officers in the counties. In the event such election shall be consolidated with any other election, the resolution calling the election hereunder need not describe the precincts, polling places, or appoint officers of election, but may refer to the ordinance, order, resolution or notice calling or providing for

such other election, or listing or designating the precincts, polling places and election officers therefor for the precincts, polling places and officers of election for the election called hereunder. Such resolution shall be published twice in some newspaper of general circulation in each county within the district and the first publication shall be at least 30 days prior to the date of election.

4. If a majority of the qualified electors voting at such election vote in favor of such dissolution, the board shall declare the results of the election, proceed to wind up the affairs of the district, and pay all indebtedness thereof. Any surplus funds shall be paid over to the counties in which the district lies in proportion to the amount last previously apportioned by the board to each county for purposes of levying taxes. The board shall exercise only such powers and secure such revenue from taxation as shall be necessary to wind up the affairs of the district

5. Upon the completion of the process of winding up the affairs of the district, the board shall, by resolution, entered upon its minutes, declare the district dissolved. A certified copy of such resolution shall be filed with the county recorder of each county within the district and with the Secretary of State. Upon the adoption of such resolution the district shall be dissolved.

SEC. 3. Section 24213 is added to the Health and Safety Code, to read:

24213. An air pollution control district which is situated in any county included within another air pollution control district created by special law shall cease to function and exercise its powers upon the date of any rules and regulations adopted by the governing body of such special district.

SEC. 4. Section 24214 is added to the Health and Safety Code, to read:

24214: When an air pollution control district ceases to function and exercise its powers pursuant to Section 24213, the property of such district shall vest in the county in which the district is located, and any funds belonging to such district at that time shall be transferred to such county and may be used for general county purposes.

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